ABSTRACT

LOBSINGER, MEGHAN ELIZABETH. Chimney Swift Program Evaluation: A Swift Recovery Stalled by Unchanged Human Behavior. (Under the direction of Dr. George Hess.)

Despite significant spending on environmental education programs, few are evaluated for effectiveness. We evaluated how educational presentations and mass-distributed brochures about chimney swift conservation impacted knowledge, attitude, and behavior (uncapping chimneys) based on survey responses and chimney cap status before and after educational programs and brochures. Presentations led to increased knowledge but no changes in attitude. Neither presentations nor brochures induced behavioral changes – no chimneys were uncapped. We recommend removing the impediments to behavior change, some of which are financial, and reducing the risk to property owners of uncapping. We also recommend improved methods of program planning, implementation, and evaluation.

Chimney Swift Program Evaluation: A Swift Recovery Stalled by Unchanged Human Behavior

by
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DEDICATION

I dedicate this thesis to my parents, Glenn and Deborah Lobsinger, without whose love, emotional, and financial support I could not have completed my Master's degree. Thank you for your patience and understanding throughout this challenging journey. And to my Grandmother, Mrs. Dorothy Williams, for the kind of love, support, and championing that only a Grandmother can provide, and for the strength that she instilled in her children and grandchildren.

I also dedicate this thesis to the chimney swifts, whose phenomenal survival adaptations and future struggles are both inspiring, and not yet fully appreciated.

"Success is not measured by what you accomplish,
but by the opposition you have encountered,
and the courage with which you have maintained
the struggle against overwhelming odds."
-Orison Swett Marden

BIOGRAPHY

Meghan Lobsinger is a Florida native-turned-North Carolinian who credits opportunities provided by her parents and family for a youth spent mostly outdoors and her early interest in wildlife and the natural world. She received her undergraduate Bachelor of Science degree in Environmental Studies with a minor in Biology at the University of North Carolina Wilmington. While in school on the coast, she spent four years volunteering as an educator at the North Carolina Aquarium at Fort Fisher, one summer working as a coastal educational camp counselor, and one summer educating the public while rehabilitating sea turtles. Immediately following graduation, she moved home to Raleigh to begin her Master of Science degree studies in Natural Resources at North Carolina State University. Once settled back home, she immediately sought a part-time job working for the North Carolina Museum of Natural Sciences, where she currently works part-time as an educator, introducing the public to the natural history of North Carolina.

Her research interests include environmental education, conservation, and land management. Her non-research interests include traveling, hiking, cooking, gardening, and photography. Following graduation, she is interested in finding ways to educate both the general public and other professionals about conservation and sustainable land management.

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Introduction

The chimney swift is not so well known or under as great a threat of extinction as the endangered black rhino, giant panda, or hawksbill sea turtle. In fact, the little bird is not a United States federally-listed threatened or endangered species at all.   The bird is not a game species, it is not a national icon, nor does the chimney swift have the "cute" factor behind which the general public will often rally for conservation support. However, some agencies and conservation groups are publicizing the current plight of the chimney swift in hopes of creating awareness of the bird's gradual population decline.

In this chapter, I will present facts and data necessary for the reader to understand the challenges faced by organizations involved in chimney swift conservation.   In particular, I will focus on the work of a local conservation organization. Wake Audubon officially dedicated 2011 and 2012 to the public awareness and future scientific research of the chimney swift, and continues to do so in 2013 with its fundraising efforts. I will also explore some of the goals and focal areas of environmental education as an interdisciplinary study, and how the attitude-behavior concept interacts with environmental education to affect pro-environmental behavior change. Finally, I will relate some theories of effective conservation program design and goal setting which will be used to analyze Wake Audubon's chimney swift educational campaign methods and procedure.

The Chimney Swift

Chaetura pelagica is a small, brown to gray bird with a lighter-gray throat. The males and females are monomorphic, meaning they are identical in appearance. This bird has a squat body with a rounded head, on average about 5 inches long. Its long, scythe-shaped wings span about 12.5 inches and cross by an inch or more over the short, squared-off tail feathers, which end in pointed bristles (hence "*Chaetura"*, meaning spiny-tailed). The long wings and bristled tail help the chimney swift support itself as it clings to vertical surfaces to rest, nest, sleep, and perform all other stationary tasks, as chimney swifts do not have the morphological ability to "perch" on a branch or some other surface or even walk on the ground like most birds (Connors, personal communication, 2011; Driftwood Wildlife Association, 2004) (Figure 1).

Figure 1. *Chaetura pelagica* with young in nest (photo in the public domain).

Usually seen only in flight, chimney swifts are often confused for bats. As they swoop low over fields and ponds and high over urban centers in search of aerial insects and chimneys to roost in overnight, their robust flight is stiff but acrobatic due to short, massive wing bones. Flight is usually accompanied by a "chippering" or "ticking" call, which is used to draw other swifts in at dusk to roost together (Connors, personal communication, 2011; p 208, Peterson, 2008).

Range and migration. The chimney swift breeds along the entire east coast of North America and southern Canada, extending to the eastern boundary of the Rocky Mountains, during the spring and summer. During fall in North America, the birds migrate *en masse* to the Amazon Basin in Peru; they return during the North American spring (p 10, Figure 2). The chimney swift is thus protected under the Migratory Bird Treaty Act of 1918. Anyone who knowingly destroys a chimney swift nest that may contain eggs or young may be fined or otherwise penalized.

Nesting and roosting limitations and their effect on population. The chimney swift's breeding range did not always extend so far west across North America. Historically, chimney swifts utilized the natural hollows of old hardwood trees for nesting and roosting sites. John James Audubon himself poetically described swifts entering a roost in a large sycamore tree near Louisville, Kentucky, in 1808 (The Ohio Ornithological Society, undated). The clearing of primeval forest in eastern North America by European colonists began the phenomenal shift in the breeding ecology of the chimney swift. As an alternative

Figure 2. Migrational range map for *Chaetura pelagica* (map by the Cornell Lab of Ornithology).

breeding site, chimney swifts adapted to nesting under eaves, in barns, and especially on the inside walls of masonry chimneys. The bird was first recorded nesting in a colonist's chimney at a cabin in Maine in 1672. Chimneys as surrogate hollows allowed for the species to move west into the primarily tree-less North American plains. As the American pioneers moved west, their cabins and chimneys with them, so did the chimney swifts. The chimney swift population was sustained, possibly even improved, by this commensalism and movement with the colonists and pioneers (Graves, 2004).

The chimney swift now relies almost exclusively on man-made chimneys for nesting and roosting habitat, an adaptation driven by past and current development, ecological succession, and the physical removal of some of the last large dead and decaying hardwoods, either for firewood or as safety precautions. In fact, as few as two dozen instances of the original tree-nesting behavior have been reported since 1900 (Graves, 2004).

The loss of natural breeding habitat in trees is not the only challenge facing chimney swift populations today. Homeowners now have the option to cap their otherwise inhabitable chimneys to avoid “pest” or wildlife occupancy, weather damage to homes, or may even be required to cap under Homeowners Association constraints. Many homes are built without the need for fireplaces due to changes in energy sources. Additionally, wood-burning fireplaces continue to be replaced with metal-lined gas or electric flues, which are uninhabitable to chimney swifts (Mordecai, R. S., presentation to Wake Audubon, 2011). As a result, chimney swifts have declined throughout their range at a rate of 2.3% per year since 1968 (Sauer et. al. 2012). Population declines increase at different rates throughout the species range. Breeding Bird Atlases in the United States and Canadian provinces show large declines in chimney swift population ranges with the largest reductions in Ontario (45%) and in Quebec (33%) (Gauthier et. al. 2007, *Breeding Bird Atlas Explorer* (online resource) 2009, New York State Breeding Bird Atlas 2000 (online resource) 2000 – 2005, New York State Breeding Bird Atlas (online resource) 1980 – 1985). Communal roosting sites have also decreased in size with roosting swift numbers declining as much as 99% over the last 40 years in Quebec (Gauthier et. al. 2007).

Between 2008 and 2010, Dr. Rua Mordecai, now the Science Coordinator for the South Atlantic Landscape Conservation Cooperative, conducted a local chimney study throughout urban areas in metropolitan Raleigh-Durham (11,800 km^2) (p 13, Figure 3). From 2008 – 2010, accessible nesting chimneys declined by 9.2%/year (95% CI: 5.1 – 14.4%) and accessible nesting chimney were extremely rare in houses built after the 1990s (Mordecai, R.S., unpublished data). This study has led Dr. Mordecai to conclude that loss of available nesting chimneys is likely contributing to a local decline in the chimney swift population over time (Mordecai, presentation to Wake Audubon, 2011).

Other statistics suggest a marked decline in the overall chimney swift population. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists the chimney swift as nationally endangered (COSEWIC 2007). COSEWIC reports that the Canadian chimney swift population has declined by 30% during the species' last three generations (about 13.5 years), and that the area occupied by the species has decreased by a third during that same period. The chimney swift is recognized on the International Union for Conservation of Nature and Natural Resources' "Red List" as "Near Threatened," meaning likely to qualify for a threatened category in the near future" (IUCN 2012).

COSEWIC lists several probable reasons for the species' decline over the past 30 years, including a loss of aerial insects, the species' principal diet, due to increased pesticide use, an increase in the frequency of hurricanes, and most significantly, a steady decrease in the availability of suitable nesting and roosting chimneys. Individual observations of school chimneys in Wake County in the early 2000s, combined with the findings of Dr. Mordecai's local chimney study in the Raleigh-Durham area in 2010, drew attention to the plight of the

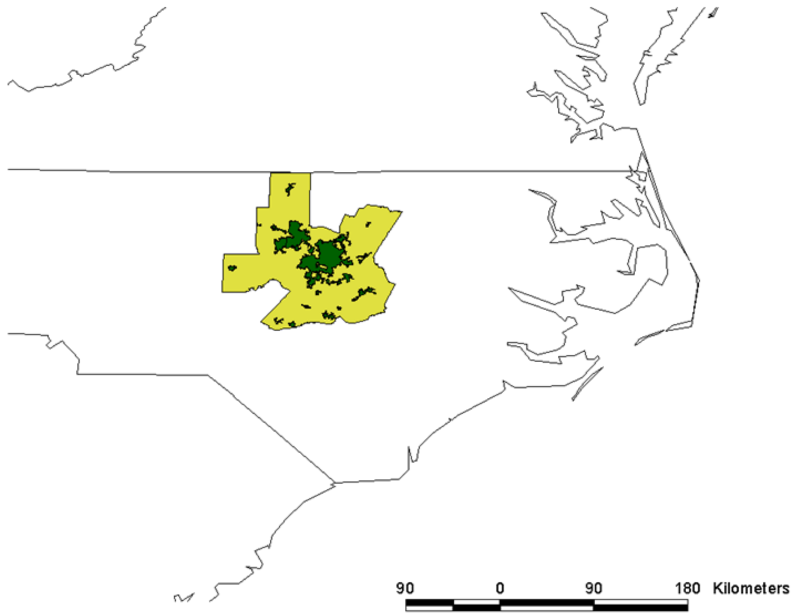

Figure 3. Dr. Rua Mordecai's 2008-2010 urban study area within the Raleigh-Durham metropolitan statistical area of 11,800 km^2 (unpublished data).

chimney swift to the local chapter of the National Audubon Society, Wake Audubon (Connors, J., personal communication, 2011).

Conservation organizations like Wake Audubon are seeking ways to maintain nesting habitat for chimney swifts. Chimney swifts require at least an 8-10 foot depth of an enclosed, vertical, coarse surface, such as wood or a masonry material, on which to cling, build their nests, and allow their young to practice flight before leaving the chimney for the first time (Driftwood Wildlife Association, 2004). There are therefore no simple bird houses for chimney swifts. Organizations such as the Driftwood Wildlife Association and many Audubon chapters across America have constructed nesting and roosting "towers" for swifts, however the individual towers are not inexpensive, and each tower will accommodate only one breeding pair of swifts per breeding season. One basic tower may cost anywhere between $300 and $650 to construct (Gerwin, J., personal communication, 2012 & Columbus Audubon, 2008). A chimney swift tower with interpretive signage and paid labor may cost up to $3,000 to construct (Gerwin, J., personal communication, 2012).

Wake Audubon's "Year of the Chimney Swift"

History and Conception. In 1998 a student at Ligon Middle School noticed hundreds of birds pouring from the opening of the school's chimney. The school contacted the North Carolina Museum of Natural Sciences, and educator John Connors was sent to speak to 160 Ligon students in their auditorium about the chimney swifts roosting in their school chimney. This event led Connors, a member of Wake Audubon into an interest in chimney swifts and their local roosting chimneys. Wake Audubon organized a volunteer effort to survey Wake County schools with inhabited roosting chimneys. Of the 105 schools surveyed, about 35 had active roosts. At about the same time, Wake County issued a public school bond which was used for updating and repairs, which included gradually replacing all the schools' heating and air conditioning systems. Wake County public school chimneys were outfitted with metal flues or heat pumps. These updates made the school chimneys uninhabitable to chimney swifts. For the next three to four years after the bond was passed, Wake Audubon observed the number of active school roosts decline from 35 to about 12. This number has gradually continued to decline as schools continue to be updated (Connors, J., personal communication, 2012).

Growing concern for the chimney swifts inspired Wake Audubon to apply for a number of grants to fund a chimney swift citizen science project at schools across the state; however none of the grants were awarded. In the early 2000s Wake Audubon began discussing a model chimney to erect on the site of a 45-acre piece of land owned by the NC Museum of Natural Sciences with the Friends of the Museum group. An experimental model based on the Driftwood Wildlife Association's blueprints (Driftwood Wildlife Association, 2012) did not attract a single swift to the chimney, leading Wake Audubon to conclude that the specifications for the model built in Texas may not work for chimney swifts in Raleigh, North Carolina. The idea to build a permanent, free-standing chimney as a research and educational tool originated as plans for the Museum's Nature Research Center were begun; Museum administrators decided the project would fit in well with the Nature Research Center's goal to bring science to the public.

Goals. Wake Audubon named 2011 & 2012 as their organization's "Year(s) of the Chimney Swift," with goals for fundraising for the chimney swift research tower and educating the public to make them more aware of the chimney swift and its declining population. One additional, particular goal of some members of the organization piqued my interest as a fellow environmental educator and researcher. Wake Audubon hoped that by providing the knowledge and, for some audiences, the opportunity to experience the roosting behavior of hundreds to thousands of swifts in one chimney, it might elicit a behavior change in audience members with potential nesting chimneys at home. The organization hoped that by gaining an awareness of the species and its population decline, along with a list of alternatives to capping, and reasons to uncap, homeowners with the appropriate chimneys would either uncap their already capped chimneys, or continue to leave their uncapped chimneys open for chimney swift nesting and breeding purposes. My research focused on evaluating these goals and studying the effects of Wake Audubon's educational methods. Local groups were solicited for presentation time, a NC Museum of Natural Sciences "Science Café" about chimney swifts was held, and a month of once-a-week excursions to downtown Raleigh to provide the public with the experience of watching swifts go to roost in large industrial chimneys was advertised and carried out. At least $3,200 was spent between 2010 and 2012 on advertising, merchandise, and educational materials and demonstrations for the campaign. The fundraising goal for construction of the research tower by Wake Audubon was $35,000. Currently the organization has managed to raise $11,000 on its own (Gerwin, J., personal communication, 2013). A partnership with the NC Museum of Natural Science's Friends of the Museum group in 2012 may have strengthened the future of Wake Audubon's fundraising resources for the project. Popularity and scheduling of the educational programs, along with continuing fundraising goals, caused Wake Audubon to extend the chimney swift's reign as "Bird of the Year" from 2011 into 2012. At this time, Wake Audubon has not announced a "Bird of the Year" for 2013. As the fundraising goal for a chimney swift research tower has not yet been met, it may be assumed that the chimney swift will once again maintain Wake Audubon's attention for the 2013 year.

Conservation & Environmental Education

Representing the World Wildlife Fund during a speech about the past and present of environmental education in 1995, Judy Braus estimated that if she were to ask her audience to define the term 'environmental education', she would "probably get as many different answers as there are people, with some similarities and some very marked differences." She reported that the three major goals and the five components of environmental education developed during the 1977 Tbilisi Environmental Education Conference have stood the test of time, with only the language, and topics such as equity and development, in need of updating and inclusion. The three goals were:

"To foster a clear awareness of and concern about economic, social, political, and ecological interdependence in urban and rural areas;

To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment; and

To create new patterns of behavior of individuals, groups, and society as a whole toward the environment."

The five components of environmental education were:

"Awareness: To help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied programs

Knowledge: To help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems

Attitudes: To help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection

Skills: To help social groups and individuals acquire the skills for identifying and solving environmental problems

Participation: To provide social groups and individuals with an opportunity to be actively involved at all levels in working toward the resolution of environmental problems".

Similarly, but with some "marked differences," Pooley & O'Connor (2000) simplified the main goals of environmental education as assessing environmental issues, finding feasible solutions to any problems that are identified, and creating pro-environmental behavior.

Challenges for Environmental Education. Braus (1995) stated that seven problems exist for environmental education, the first being a lack of acknowledged priority of environmental education in schools. This may be explained by the second and third problems: the fact that the interdisciplinary nature of environmental education means that it doesn't have a "home" in the structured breakdown of an already full science curriculum, as well as school curriculums with no clear priorities. A lack of effective and adequate pre-service and in-service training for educators and gaps in materials and training mean that basic environmental awareness and knowledge in students are good, but developing skills, investigating values, and creating a commitment to take action is not addressed by educators. Braus stated that there is also too much of a focus on school-age kids. This may be supported by the abundance of knowledge, behavior and attitude studies conducted on grade-school students found by this literature review (Lorenzoni et al., 2007, Smith-Sebasto & Semrau, 2004, Pomerantz, 1990-91, Ramsey et al., 1981, and Asch & Shore, 1975), but relatively few studies found that were conducted on young-adult students or adults (Boyes & Stanistreet, 2012 and Xiaoyun, 2010). While it has been found that environmentally educated school-age children can create pro-environmental behaviors in their parents and the community around them (Vaughan, 2003), some organizations may wish to target behaviors that are not appropriate for, or that young children would not have the capacity to change in either themselves or their communities. Finally, Braus (1995) concluded that there is a lack of communication and collaboration amongst educators to establish and share effective curriculums and programs.

Pooley & O'Connor (2000) believe that the main focus of environmental education has trended towards changing environmental behavior through increasing environmental knowledge, and that many researchers, themselves included, would disagree that this method is the best way to change behavior. "A challenge to the field of natural resource [environmental] education is, first, to make [people] aware of key resource management [environmental] issues and, second, to bring them beyond awareness to an informed, participatory level" (Pomerantz, 1990-91).

Attitudes & Behavior and Associated Variables

The literature for environmental attitudes and behaviors and potential ways to change them is abundant and equivocal. Hines et al. (1986) performed a meta-analysis of research on environmentally responsible behavior and found that pro-environmental attitudes and pro-environmental behavior could be associated with six variables: knowledge of environmental issues, knowledge of action strategies, locus of control (perceived internal or external control of the issue), attitudes, verbal commitment, and an individual's sense of responsibility. They sorted these variables into three categories and conducted meta-analyses on as many existing environmental attitudes and behavior literature and studies as they could find. The three categories were: cognitive variables, psycho-social variables, and demographic variables.

Cognitive Variables. Hines et al. (1986) found a positive correlation coefficient of 0.299 (SD = 0.195) between cognitive variables (knowledge) and pro-environmental behavior. They concluded that individuals with greater knowledge of environmental issues or knowledge of how to take action on those issues were more likely to report engaging in responsible environmental behaviors than those who did not possess such knowledge. More recently, in a study of young adult students in the United Kingdom, Boyes & Stanistreet (2012) found no such strong link between a person's general environmental attitudes and knowledge and his or her willingness to undertake pro-environmental actions. They inferred that altering a person's belief (which they imply is determined by a combination of the person's knowledge and attitude) about certain issues will have little effect on their actual willingness to act, or their behavior (the authors use these words interchangeably), as other contributing factors may interfere. Similarly, Lorenzoni et al. (2007) argued that although there may be widespread awareness of an issue, like climate change, and a general concern, there may still be limited behavioral response to the issue.

Psycho-social Variables. The psycho-social variables included attitudes, locus of control, economic orientation, personal responsibility, and verbal commitment. Hines et al. (1986) broke the attitude variable down into two sub-variables in relation to pro-environmental behavior. The relationship between attitudes toward ecology and the environment as a whole and behavior ($r = 0.338$, $SD = 0.243$) was slightly less strong than attitudes toward taking actual environmental actions and behavior ($r = 0.377$, $SD = 0.145$) (Hines et al. 1986). They found that those individuals who reported having an internal locus of control, or a higher "efficacy perception," were more likely to have reported engaging in responsible environmental behaviors than were individuals exhibiting a more external locus of control, or lower "efficacy perception". In other words, individuals who felt that they had the personal ability to engage in particular environmentally responsible behaviors and have a positive effect on the environment through their actions were more likely to do so than individuals who did not believe that this power was under their control. They also found that those individuals who expressed an intention to perform some action related to the environment were more likely to have reported engaging in environmental behaviors than were individuals who had expressed no such intentions ($r = 0.49$, $SD = 0.130$). Conversely, Downing & Ballantyne (2007) argue that "any response of an individual indicating that they intend to act will not necessarily mean that they will do so." Wicker (1969 & 1971) provided some reasons why intended and actual behaviors are not always equal; these theories are explored in the "Attitude-Behavior Concept and its Impact on Conservation Education" section, below.

Hines, et al. (1986) also determined that individuals who felt some degree of personal concern and responsibility toward the environment were more likely to have engaged in responsible environmental behaviors than were individuals who held no such feelings of responsibility (r = 0.328, SD = 0.121). Boyes & Stanisstreet (2012) tend to agree. They found that the "Natural Willingness to Act" was greater in individuals who felt a higher degree of concern towards the environment, even if these individuals did not have a high "efficacy perception" towards certain pro-environmental behaviors. On the other hand, even a relatively strong belief in the effectiveness of an action will not necessarily result in its application, possibly due to other looming disincentives.

Finally, Hines et al. (1986) found there was too weak a correlation between economic orientation (an individual's cost consciousness and concern about the economic impact of certain responsible environmental behaviors) and pro-environmental behaviors (r = 0.162, SD = 0.118) to conclude a relationship existed between the two variables. However, Boyes & Stanisstreet (2012) maintain that situational influences, including economic concern, may dominate a decision, even if there is a strong believed effectiveness of an action and a willingness to act.

Demographic Variables. Demographic variables assessed in the Hines et al. (1986) meta-analysis included age, income, education, and gender. These four variables produced weak correlation coefficients with pro-environmental behavior. Because of this, the authors could not conclude that individuals with higher incomes (r = 0.162, SD = 0.084), more education (r = 0.185, SD = 0.122), or that were younger (r = -0.151, SD = 0.200) meant that they were more likely to have reported engaging in responsible environmental behaviors than individuals with lower incomes, less education, or that were older.

Hines et al. (1986) also concluded that there appears to be no relationship between gender and responsible environmental behavior. On the other hand, Boyes & Stanistreet (2012) determined that young-adult female students in the United Kingdom tended to be more sensitive to the benefits of certain pro-environmental actions, and were more willing to undertake other pro-environmental actions not assessed by their study. Those authors' conclusion is consistent with the observations of Burger et al. (1998) and Taskin (2009), that females tend to score more highly on instruments that measure environmental attitudes.

The Attitude-Behavior Concept and its Impact on Conservation Education

Pomerantz (1990-91) conducted a meta-analysis of 700 different environmental programs in the United States which revealed that 543 programs addressed knowledge, 124 addressed attitudes, and 42 addressed behavior. The same study conducted an assessment of school curricula in environmental education and natural resource education materials for elementary students, and the research indicated that environmental education programs primarily address base-level goals of environmental awareness and knowledge. Very little attention is given to specific resource management issues, and few programs encourage students to develop analytical skills and pro-environmental behavior beyond cultivating basic environmental issue awareness, knowledge, and attitudes.

What has become extensively studied and known to social science as the "attitude concept" may have created these hold-ups in environmental and conservation education. In a review of attitude studies, Wicker (1969) quotes that the attitude concept has been described as "the primary building stone in the edifice of social psychology." He goes on to recite that the popularity of the attitude concept may have arisen due to social psychologists assuming that attitudes have a lot to do with social behavior, that "attitudes are always seen as precursors of behavior, as determinants of how a person will actually behave in his daily affairs." In another study, Wicker (1971) showed that attitudes are in reality "often unrelated or only slightly related to overt (actual) behavior," that "only very infrequently did attitudes account for more than 10% of the variance in the overt behavioral measures." In fact, Wicker (1971) determined that the best predictor of behavior was "judged influence of extraneous events". Wicker (1969) postulated that two types of factors can influence attitude-behavior relationships: personal and situational. Personal factors include: competing motives, verbal, intellectual, and social skills, activity levels, and other attitudes. Situational factors include: the actual or considered presence of other people, social norms, alternative options available, specificity of the behavior objective, unforeseen extraneous events, and expected and/or actual consequences of the behavior. Overall, "the more similar the situations in which verbal and overt behavioral responses are obtained, the stronger will be the attitude-behavior relationship." The likelihood of any particular pro-environmental action or behavior actually being adopted is the result of the interaction between a general feeling of benefitting the environment weighed against personal incentives, disincentives and concerns (Boyes & Stanisstreet, 2012).

In 1975 Asch & Shore conducted a study on the premise that there had already been much research and several studies on environmental education and conservation, but most of it centered on this attitude-behavior concept. They placed one group of children who had been exposed to a formal program of environmental education, and one that had not, in a natural setting, gave them a construction objective, and observed which group demonstrated more conservational rather than destructive behaviors while completing their objective. As can be conjectured, the experimental (educated) group demonstrated more conservation-minded behavior, whereas the control group was more destructive. Asch & Shore resolved that it is not necessary to rely solely on attitude measures and "experienced opinions" (suggestions without empirical research) to demonstrate the contribution that can be made by an environmental education program. They concluded with the idea that "emphasis should be placed on measuring the actual behavior that environmental education programs are intended to influence. This behavior can be influenced in the desired direction." This is a rare example of a study which attempted to measure the effectiveness of an environmental education program on behavior change. Similar studies like this are described in Section 8, below.

Hines et al. (1986) formed a series of conclusions pertaining to increasing the incidence of higher actual environmental responsibility through environmental education. Classroom strategies that placed emphasis on a combination of knowledge of environmental issues, discussions of alternative solutions to environmental problems, the development of issue investigation skills, environmental problem-solving skills, values discussions, and action-taking skills improved the probability of higher environmental responsibility in audience members. Similarly, Ramsey et al. (1981) inferred that environmental action-taking skills instruction developed a more comprehensive preparation for overt environmental action behavior by supplying both the knowledge about skills needed to remediate environmental problems and practice in the use those skills. Programs which focused on short-term (one day) exposures, on the other hand, were more ineffective in developing responsible environmental behaviors (Hines et. al, 1986). The “offering of appeals,” information, incentives and feedback were also found to be highly more probable to increase the incidence of pro-environmental behaviors. Hines, Hungerford, and Tomera (1986) proposed a model of responsible environmental behavior that suggests programs with goals for pro-environmental behavior change that focus on developing action skills and increasing knowledge of action strategies, combined with increasing knowledge of environmental issues and affecting personality factors such as attitudes, are more likely to meet their goals (p 28, Figure 4).

Effective Conservation Program Design and Goal Setting

While the literature on general educational program design and goal setting is plentiful, the same may not be said for conservation education with specific goals for behavior change. Many existing studies provide broad suggestions. For example, after studying China’s non-governmental environmental education programs, Xiaoyun (2010) suggested that knowledge transmission, establishing sentimental ties between the participants and the environment, promoting behavioral changes based on knowledge and sentimental identification, and attaching importance to the role of the media were shared efforts that have contributed to the gradual positive socio-political changes in China with regard to the environment. While

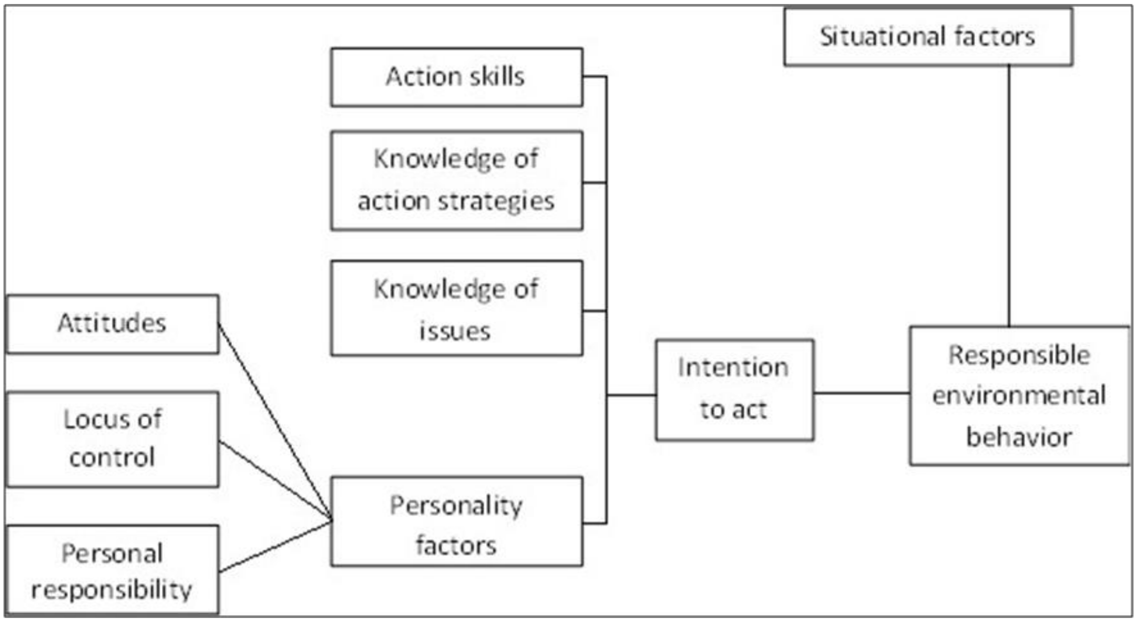

Figure 4. Hines, Hungerford, and Tomera's (1986) Proposed Model of Responsible Environmental Behavior.

these and other study findings are positive, few suggest how an organization should go about convincing the public to make specific behavioral changes for conservation.

One useful piece of literature on the subject is a book called *Conservation Education and Outreach Techniques*, by S. K. Jacobson, M. D. McDuff, & M. C. Monroe (2006). In a review, J. C. Ady (2007) called the book "a comprehensive source book for conservation education and outreach techniques…" that will "soon earn its rightful place as a tool as essential to a conservationist's work as a field guide or a pair of binoculars."

The "PIE" Process. I will be using a modified version of the Jacobson et al. (2006) Planning-Implementation-Evaluation (PIE) process to assess the Wake Audubon chimney swift program. The PIE process is meant to help conservation educators avoid program problems such as “targeting the wrong audience or using an inappropriate medium,” and is as follows:

“Planning

What is the conservation problem or issue you want to address?

What are your goals and objectives?

What audiences or stakeholders are involved in the issues to be communicated?

What are their backgrounds, needs, interests, and actions?

For each audience, what changes or actions are desired?

How can audience members be involved in the planning process?

What constraints and resources are there?

What messages must be sent?

What channels and activities will most efficiently result in the desired changes in knowledge, attitudes, or behaviors?

Implementation

What modifications are indicated by pilot tests of activities and materials?

Is scheduling, funding, and staffing adequate and efficient?

Evaluation

How will you know if the strategy worked?

What are the outputs and outcomes of the program?

Have you assessed key indicators of success, such as changes in the environment or in audience knowledge levels, attitudes, or behaviors?"

Planning. Appropriate planning helps conservation educators develop effective programs by reviewing the mission of their organization and the goals for the educational outreach program, identify target audiences (which may either be a broad audience for a general awareness campaign or an audience practicing specific behaviors which the organization wishes to change), and develop objectives and activities for the program and each audience in order to meet the organization's goals. According to Jacobson et al (2006), goals should address broad conservation problems while inspiring specific and measurable objectives for each target audience. The authors suggest that organizations whose goals involve changing an audience's knowledge, attitude, or behaviors should have at least three objectives: first, to increase awareness about the issue, second, to focus on increasing concern or shifting an attitude, and finally, to encourage a specific conservation action or behavior. Jacobson et al. (2006) describe an effective program objective as being SMART:

"*Specific* Describes a behavior or outcome that is observable.

Measurable Provides quantifiable indicators of progress toward achieving the objective.

Audience-focused Identifies the audience and describes outcomes in terms of what the audience will be able to do.

Relevant Details a meaningful and realistic task and impact for the audience.

Time-limited Gives a definite time frame for achieving the objective."

Jacobson et al. (2006) placed great importance on target audience research previous to designing a conservation program. Having a good background familiarity with the target audience's needs, demographic information, socio-psychological profiles, baseline knowledge, attitudes and behaviors can help an organization tailor a program's activities, techniques, and messages, and can overall produce a more effective program. Involving potential audience members and partners in the planning process and having a realistic view of your organization's time, personnel, funding, and other resources is also suggested. Jacobson et al. (2006) make the suggestion that research should be conducted not only before a program, but after as well, evaluating the results of the program. This post-program research can help determine if the program's objectives were achieved and if there were any unanticipated or secondary impacts. This practice is an uncommon occurrence in literature, but conservation education research would benefit from its support and application.

Implementation. Jacobson et al. (2006) emphasize pilot testing of conservation programs. Pilot tests, conducted before a program is implemented fully, can help ensure that the objectives and planned activities are effective and allow the program designers to make necessary changes before implementing a potentially costly program that will inevitably fail. The authors suggest that during the actual implementation of a conservation program, a final schedule, budget, and formalization of program educator responsibilities should be established, along with a system for monitoring program operations and evaluating program results.

Evaluation. Most important to my study is the “E” in the “PIE”- the evaluation of a conservation program. Evaluation of a program reveals if the program is worth the time, money, and resources of the organization. Evaluation determines whether the program objectives were met, if it was cost-effective, and if modifications to program design should be made in the future (Monroe, 2009 & Jacobson, et al. 2006). Severe unanticipated or secondary impacts may follow ineffective conservation programs: the program may fail to reach the target audience, program messages may be misunderstood, the wrong behavior may be targeted, or the natural resources the organization meant to protect may be inadvertently harmed (Jacobson et al., 2006).

The evaluation method that Jacobson et al. (2006) recommended is a formal before-and-after survey of the target audience. Some evaluative questions for the organization to seek answers to regarding a conservation program are as follows (Jacobson et al., 2006):

“Did the target audience receive the message?

Were the materials recognized; was the message remembered?

Was the audience interested, satisfied, or engaged with the activity?

Are there changes in audience knowledge, attitude, or skills?

Are there long-term changes in resources use or participant behavior, or increased concern for environmental management or conservation legislation?

Are there improvements in the wildlife, ecosystem, or other conservation target?"

Post-Program Evaluation Studies

Challenges for Evaluation. Because environmental education programs encompass a broad range of topics and issues, each program comprised of its own individual goals and techniques, there are few standard evaluations to be copied from one program to the next. This means that most programs require unique evaluations to determine changes in environmental or conservation awareness, knowledge, attitudes, skills, intention, and behavior (Monroe, 2010). The capacity for some organizations to develop and implement individual evaluations for every program they conduct may not exist, especially if the programs are developed by organizational members and educators that have not been trained with the evaluatory skills that many scientific researchers and evaluators possess (Fleming & Easton, 2010 and Monroe, 2010). Other challenges to evaluation include a failure to prioritize evaluation as an important program and organizational component, concern over the possible negative consequences of evaluation, and a lack of incentives for conducting evaluations, as well as the opposite- a lack of consequences for evaluation avoidance (Tao, 2011).

Evaluation Studies. The majority of environmental education programs have failed to incorporate high quality, systematic evaluation into their programming. The examination of 56 published reports from conservation education programs revealed that less than one-third reported formative evaluations, and less than one-quarter conducted even summative evaluations (Tao, 2011). Studies like Asch & Shore's (1975), where behavior change is measured post-environmental education program, are therefore few and far between; however, they do exist. Smith-Sebasto and Semrau (2004) implemented a pre- and post-survey instrument on sixth-graders who underwent a rigorous 4-day/3-night environmental education program to assess changes to the students' attitudes toward the environment. They found that although the program was ineffective at altering the students' overall environmental attitudes, the program was effective at increasing individual environmentally-responsible behaviors, according to their instrument. Ramsey et al. (1981) instructed eighth-grade students on environmental case studies and associated pro-environmental actions. They found that "environmental action instruction providing training directed at environmental action problem-solving skills tended to increase eighth-grade students' knowledge of environmental action skills and techniques." Their data also showed that students who participated in the training used more remediative environmental behaviors more frequently, post-instruction, than students who did not undergo the training. They determined that a specific knowledge of, and ability to utilize, environmental action strategies encourage environmental action behavior, and that environmental issue awareness education alone is not likely to foster environmental action. Specific training in both awareness and application of skills, combined with environmental information and values, is necessary to encourage "successfully independent overt environmental behavior." Both effective conservation and environmental education program design and evaluation are therefore crucial for conservation organizations who wish to develop effective education programs that will encourage pro-environmental behavior change.

Conclusion

Chimney swift populations are declining, and conservation organizations have taken notice. Wake Audubon of Raleigh, NC has implemented a conservation education campaign to increase awareness of the bird's struggles and persuade the public to uncap their chimneys for nesting habitat. However, studies have shown that environmental awareness and knowledge alone may not foster pro-environmental behavior. Increased knowledge of the chimney swift, even an indicated change in attitude and a positive intention to uncap their chimney may not necessarily yield an actual observed behavior change due to extraneous reasons. In the following chapter I will analyze the conservation education campaign employed by Wake Audubon. I will examine the results and components of the study, including its planning and implementation procedure, and evaluate the study based on many of the objectives set forth by Jacobson et al. (2006) and other literature.

CHAPTER 2: CHIMNEY SWIFT PROGRAM EVALUATION: A SWIFT RECOVERY STALLED BY UNCHANGED HUMAN BEHAVIOR

INTRODUCTION

Over 330 years ago, the chimney swift tied its fate to mankind when habitat loss forced the small birds to begin nesting and roosting in the masonry chimneys of American colonists (Wake Audubon 2011). Naturally nesting in pairs or roosting together in the hundreds to thousands in the hollows of large hardwood trees, chimney swifts made a phenomenal adaptive shift when these large trees were cut down for lumber or firewood. For a time the new relationship worked, possibly even increasing the chimney swift population (Graves, 2004). As American pioneers built their homesteads into the western United States, the chimney swifts moved west as well, as far as the eastern side of the Rocky Mountains.

Homes constructed since the 1990s typically have fireplaces that are gas or electric, or are lined with metal flues, that chimney swifts cannot use for nesting. Remaining masonry chimneys are frequently capped to prevent entry of wildlife, such as raccoons, bats, and differing bird species, or to protect the chimney from the elements. Some homes do not have fireplaces at all due to alternative home-heating solutions. In the Raleigh-Durham, North Carolina, urban metropolitan area between 2008 and 2010, accessible nesting chimneys declined by 9.2%/year (95% confidence interval: 5.1 – 14.4%) (Mordecai, unpublished data). This loss of the substitute nesting and roosting habitat that the chimney swifts shifted to in the Colonial days is significantly adding to a gradual decline in population throughout their range, a rate of 2.3% per year since 1968 (Sauer et al, 2012). Large, hollowed out hardwoods are still a rarity for the birds to find in nature due to deforestation, development, and ecological succession.

The Wake Audubon Society of Raleigh, NC, adopted the chimney swift as a conservation campaign focus in 2011 and has continued raising awareness and funds for a chimney swift research tower throughout 2012 and into 2013. The organization conducted educational programs in three forms between 2011 and 2012 to teach the public about the species' natural history, behaviors, population decline, and alternatives to chimney capping. Some members of Wake Audubon also hoped to convince homeowners with potential nesting chimneys to uncap (or leave uncapped) their chimneys for chimney swift breeding purposes throughout their North American breeding season. A potential nesting chimney is a chimney constructed of wood, brick, stone, clay, or some other masonry material with a coarse interior (i.e. it is not lined with a metal or porcelain flue) that is at least 8 to 10 feet deep.

Wake Audubon identified three goals for the chimney swift campaign, the last two of which were evaluated by this study:

- Raise funds for a chimney swift research chimney;
- Educate the public about chimney swifts and raise awareness about the chimney swift's population decline;
- Convince people to uncap their chimneys for chimney swift nesting purposes.

Objectives. Our overall goal was to evaluate the effectiveness of Wake Audubon's chimney swift campaign, as measured by changes in knowledge, attitude, and behavior. Specifically, we asked:

1. Was Wake Audubon reaching the right target audience – owners of homes with suitable nesting chimneys?
2. Did the presentations about chimney swifts increase the *knowledge* of those who attended?
3. Did the presentations about chimney swifts change the *attitudes* of those who attended?
4. Did the presentations or mass-distributed educational brochures change the *behavior* of those who received them – did they uncap their chimneys?
5. Did the answer to questions 2-4 vary among socioeconomic groups?

METHODS

This study was commissioned by Wake Audubon after the initial planning process for the "Year of the Chimney Swift" campaign was completed. We were therefore restricted to interpreting research collected before and after the conservation education programs were implemented using a formal survey in an attempt to provide the organization with an evaluation of its chimney swift programs.

Program Evaluation Study

Wake Audubon created three types of conservation education programs, which we will call the "Science Café," "Swift Talks," and "Swift Walks." The same chimney swift facts were conveyed and the same survey administered for each program type. The same presenter led each program type, with one additional presenter joining him during the Science Café.

The Science Café is a regular series of informal scientific talks hosted by the NC Museum of Natural Sciences at a local Raleigh restaurant. Audience members pay for at least one drink or food item at the bar to participate. During the study period, only one Science Café about chimney swifts was held. Wake Audubon educators spoke about chimney swifts in a conversational rather than a lecture tone.

Swift Talks were formal PowerPoint presentation-style programs held at the regular meeting locations of various solicited garden clubs, Audubon chapters, and other groups and organizations. Some of the talks were given to organizations that Wake Audubon approached and some to organizations that approached Wake Audubon.

Swift Walks were held in downtown Raleigh every Sunday in September, 2011. These events began at the NC Museum of Natural Sciences and ended on the top level of a parking deck for a live viewing of chimney swift roosting behavior.

Survey design.

We designed one pre- and post-program survey to be administered during chimney swift conservation programs hosted by Wake Audubon for the three different program types (Appendix C). Pre-program surveys were not collected before the post-program survey was administered. Survey questions focused on chimney swift knowledge (both before and after each program), chimney-nesting bird conservation attitude (both before and after each program), respondent chimney and cap status, respondent intent to either cap or uncap their habitable chimney after attending a chimney swift program, and the collection of addresses belonging to respondents with potential nesting chimneys. The survey also collected basic demographic information: age, gender, race, income, and formal education level.

The survey instrument was first pilot-tested on a student wildlife club at NC State University. The pilot survey allowed us to realize weak points of specific questions and necessary additions to the survey. Survey design and protocols were reviewed and approved by NC

State University's Institutional Review Board for the Protection of Human Subjects in Research (Appendix B).

To determine if any respondents changed their behavior (uncapped or capped their chimney), we solicited voluntary provision of home addresses from respondents who indicated that they had a suitable nesting chimney. Respondents were assured that their home addresses would not be used or sold for purposes beyond this study.

Analysis.

We tested for statistically significant differences in knowledge and attitude before and after the educational programs. For each question, only responses with answers for both the pre- and post-program question were included in the analysis. Responses of "Unsure" for attitude were also excluded from the analysis. We used a logistic regression model to test the global null hypothesis (model significance), receive a Type 3 Analysis of Effects (significance of main effects and their interactions), and to find the profile likelihood confidence interval for odds ratios for both knowledge (Appendix D) and attitude (Appendix E). All statistical procedures were applied to all survey respondents as a whole, and then by education treatment (program). We used SAS Enterprise Guide software for all analyses.

Educational Brochure Study

We selected the area within Raleigh, NC's, "Inner Beltline" (Interstates 40 and 440) for the distribution of 600 educational brochures (p 44, Figure 5). Most of the homes in this area were constructed before the early 1990's when masonry chimneys were more common, thereby increasing the probability of suitable nesting chimneys being present.

We used 2010 US Census tracts to subdivide our study area and stratified our sample by census tract mean household income (US Census Bureau 2010; Table 1; p 44, Figure 5).

Table 1. Educational brochure distribution study income brackets with associated 2010 United States Census tract numbers and income ranges

Income Bracket	Target Income Range	Selected 2010 US Census Tracts	Selected Census Tract Incomes
Highest	>$120,000	517	$203,478
Middle	$60,000-$120,000	501, 504, 505, 514, 515.02, 524.04	$60,647 - $107,710
Lowest	<$60,000	506, 507, 508, 509, 510, 519	$19,957 - $56,149

Resource constraints limited us to 600 brochures and compact, walkable study areas. Our goal was to distribute 200 brochures within each income category to homes with capped but otherwise suitable chimneys. Within income categories, we selected census tracts based on our knowledge of land use (residential versus commercial and institutional), compactness, and walkability within the tract. Generally, we started by examining the largest tracts in each income category, discarding tracts that had a low proportion of residential land use and were difficult to walk. For selected tracts, we mapped the streets and walked each tract in a spiral

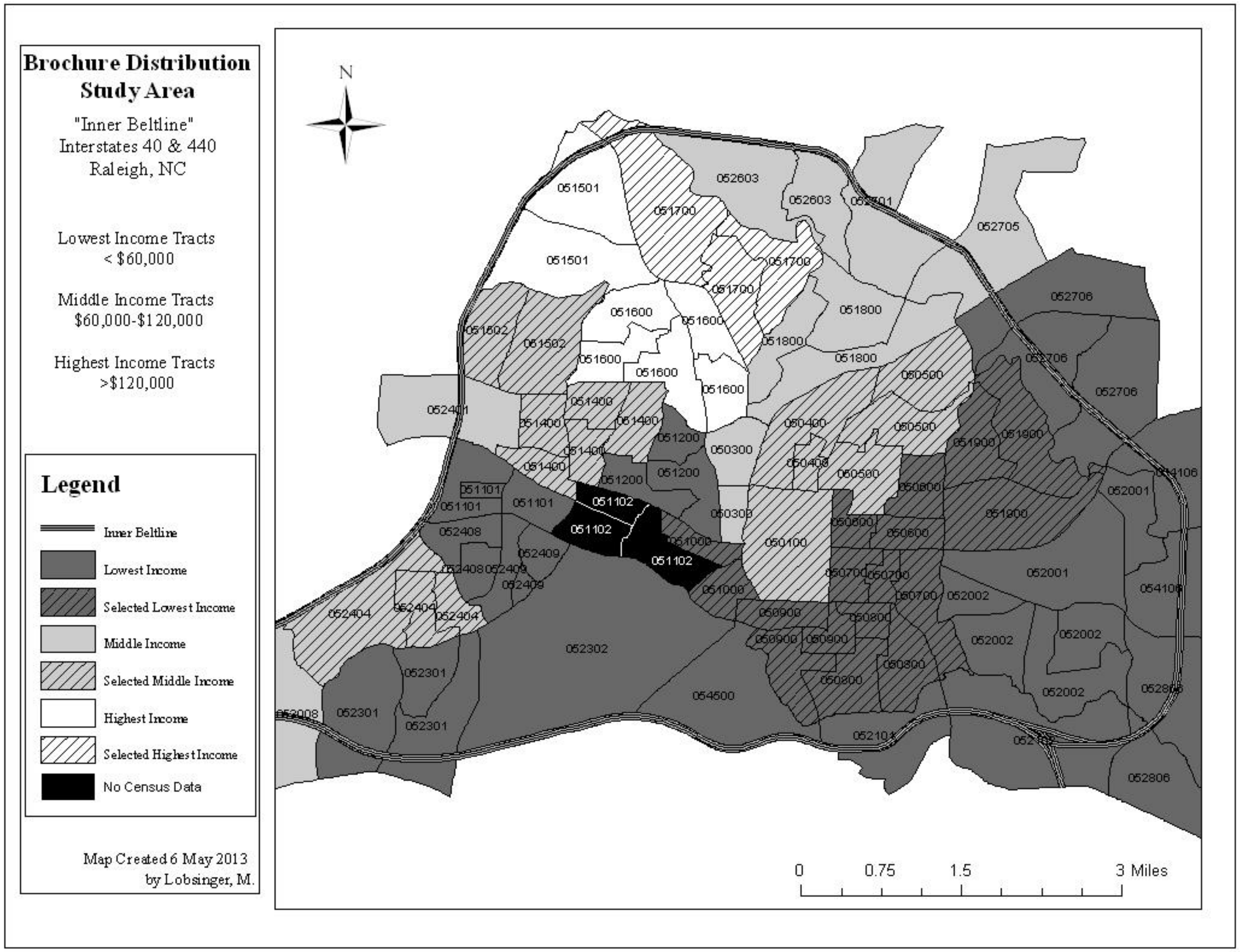

Figure 5. Potential and selected 2010 US Census tracts within Raleigh, NC's Inner Beltline (Interstates 40 and 440) for the educational brochure distribution study.

pattern from the outside in, toward the center of the tract until we had collected addresses for 200 homes with appropriate chimneys. If we did not reach the goal of 200 homes, we selected another tract in the income category and repeated this procedure.

The brochures were developed by the same individual that designed Wake Audubon's similar "Buy-a-Brick for Swifts" brochure so that the content and brochure styling would match other materials distributed throughout Wake Audubon's chimney swift campaign. The brochures, which provided both general educational chimney swift information and an appeal to the homeowner to uncap their chimney(s) for chimney swift nesting and breeding purposes (Appendix A), were mailed to the 600 addresses using Wake Audubon's normal bulk mailing process.

Three months later, all 600 homes were observed again to determine if there was any change in chimney cap status. Because some homes in our sample had multiple chimneys, some capped and some uncapped, we also noted if uncapped chimneys were capped. This would have suggested our brochures having an opposite intended effect on the homeowners. If we could not determine the post-brochure cap status of an individual home, either due to vegetation growth or temporary roof construction, we interviewed that homeowner to determine if a cap status change had been made in the past three months. Our research methods were reviewed and approved by NC State University's Institutional Review Board for the Protection of Human Subjects in Research (Appendix B).

RESULTS

Program Evaluation Study

Audience.

54% of audience members, across all venues, lived in homes with chimneys suitable for chimney swifts. About 4% were unsure whether their chimney was suitable. Of the respondents who answered that they did have a potential nesting chimney or were unsure of their chimney status, 61% indicated that their chimney was capped. Almost 18% were unsure of their cap status and about 21% indicated that their potential nesting chimney was uncapped.

The typical chimney swift educational program attendee could be described as an almost 61 year-old white female, with a degree of higher education (either a Bachelor's degree or a Master's degree or PhD), and a household income of over $75,000 per year.

The mean age for all survey respondents was 60.9 years, with an audience age range between 24 and 93 years (p 47, Table 2).

A little over 65% of survey respondents were female. 96% of respondents indicated that they were white/Caucasian. Almost 45% of all respondents indicated that they had a Master's degree or a PhD, and approximately 32% indicated that they had a Bachelor's degree. At least 49% of all respondents indicated a household income of $75,000 or more per year (p 48, Table 3).

Table 2. Average, minimum, and maximum age for survey respondents; n = number of responses and SD = standard deviation.

	n	Mean	SD	Minimum Age	Maximum Age
All Responses	242	60.9	14.3	24	93
Science Café	33	48.8	13.9	25	73
Swift Talks	141	65	13.9	24	93
Swift Walks	68	58.5	11.2	27	82

Table 3. Summary of demographic survey data for all responses and by education type in percentages, where n = number of responses.

Variable		All Responses	Science Café	Swift Talks	Swift Walks
Gender	n	255	34	152	69
	Female	65%	62%	66%	64%
	Male	35%	38%	34%	34%
Race	n	252	34	149	69
	White	96%	97%	97%	96%
	Black	2%	0%	2%	1%
	White+Black	<1%	0%	1%	0%
	Hispanic	<1%	3%	0%	0%
	White+Hispanic	<1%	0%	1%	0%
	White+Hawaiian	1%	0%	0%	3%
Education	n	254	35	150	69
	High School/GED	3%	3%	2%	4%
	Vocation or Trade	2%	0%	3%	3%
	Some College	10%	11%	11%	7%
	Associate's	8%	3%	9%	9%
	Bachelor's	32%	54%	28%	30%
	Master's or PhD	44%	29%	47%	46%
Household	n	202	31	113	58
Income	Less than $20,000	4%	10%	3%	3%
	$20,000 to $39,999	16%	23%	16%	12%
	$40,000 to $59,999	21%	16%	25%	16%
	$60,000 to $74,999	10%	6%	12%	9%
	$75,000 or more	49%	45%	44%	60%

Knowledge change.

Respondents answered all five knowledge questions correctly more frequently after the presentations than before, across all venues (p 50, Table 4). Our knowledge model was significant for all knowledge questions together and by each individual question (p 51, Table 5). The total knowledge change (all questions) was statistically significant between the pre- and the post-program survey responses for all three program types (p 51, Table 6). Respondents who attended the Swift Walks were 4 times more likely to answer the knowledge questions correctly than not after attending a Walk, as depicted by the profile likelihood confidence interval for odds ratios estimates (in bold) (p 44, Table 7). Respondents who attended the Science Café were over 10 times more likely to answer correctly after attending the Café. Swift talks were the most successful in terms of knowledge retention post-program, as respondents who attended the Swift Talks were over 14 times more likely to answer the knowledge questions correctly after attending a Talk.

Table 4. Percent correct responses for each knowledge question and for all questions; where n = number of responses with answers for both the pre- and post-survey.

Question	Education Type	n	Before	After
1. Chimney swift populations have (increased/decreased/remained the same) since the 1970s.	All	212	89%	99%
	Café	31	90%	100%
	Talks	120	89%	99%
	Walks	61	87%	98%
2. Chimney swifts cannot (perch/fly/make noises).	All	206	79%	100%
	Café	32	75%	97%
	Talks	117	78%	100%
	Walks	57	74%	100%
3. Chimney swifts migrate between North America and (Africa/South America/Europe).	All	209	89%	99%
	Café	27	96%	100%
	Talks	121	85%	98%
	Walks	61	93%	100%
4. Chimney swifts will only nest in your chimney between (April & August/October & February/chimney swifts don't use chimneys).	All	219	63%	95%
	Café	32	53%	88%
	Talks	123	77%	98%
	Walks	64	39%	92%
5. How many pairs of chimney swifts will nest in your chimney at one time?	All	216	40%	94%
	Café	31	42%	97%
	Talks	64	42%	95%
	Walks	60	33%	92%
ALL Questions	All	155	72%	98%
	Café	25	75%	98%
	Talks	82	76%	99%
	Walks	48	64%	98%

Table 5. Global null hypothesis test for all questions together and by each individual question; a test of the likelihood of the null hypothesis, a proposition which implies no effect or no relationship between variables; where DF = degrees of freedom and Pr > ChiSq is the p-value; if the p-value is greater than 0.01, the null hypothesis cannot be rejected; all tests were significant (the null hypothesis could not be rejected), meaning the statistical model was significant.

Testing Global Null Hypothesis: BETA = 0				
Knowledge Question	Test	Chi-Square	DF	Pr > ChiSq
All Questions	Likelihood Ratio	286.31	5	<.0001
Question 1	Likelihood Ratio	27.24	5	<.0001
Question 2	Likelihood Ratio	67.80	5	<.0001
Question 3	Likelihood Ratio	30.02	5	<.0001
Question 4	Likelihood Ratio	117.08	5	<.0001
Question 5	Likelihood Ratio	178.66	5	<.0001

Table 6. Type 3 analysis of effects for all questions together; a test of the significance of the main effects and their interactions; where “Venue” is the program type, “Before vs After” is the knowledge change between the pre-program survey and the post-program survey, “Before vs After by Venue” is the significance of the interaction between knowledge change and program type, DF are the degrees of freedom, and Pr > ChiSq is the p-value.; ** indicates a significant statistic.

Type 3 Analysis of Effects for All Questions			
Effect	DF	Chi-Square	Pr > ChiSq
Venue	2	10.92	**0.0043
Before vs After	1	125.41	**<.0001
Before vs After by Venue	2	15.26	**0.0005

Table 7. Profile likelihood confidence intervals for odds ratios; where ** indicates a significant interaction; "Café vs Talks After Program" compares how much more likely respondents who attended the Café were to answer correctly than not after being educated at a program than respondents who attended a Talk, etc., and "Knowledge Change After Café/Talks/Walks" compares the total knowledge change by program type; the Estimate indicates how much more likely respondents were to answer correctly than to not answer correctly after attending a program.

Profile Likelihood Confidence Intervals for Odds Ratios

Label	Estimate	95% Confidence Limits	
Café vs Talks After Program	0.57	0.23	1.63
****Café vs Walks After Program**	3.41	1.51	9.14
****Talks vs Walks After Program**	5.96	3.28	11.35
****Knowledge Change After Café**	**10.41**	4.65	27.87
****Knowledge Change After Talks**	**14.27**	8.58	25.56
****Knowledge Change After Walks**	**3.88**	2.60	5.91

Attitude.

18% of all respondents changed their attitude question response during one of the chimney swift programs. Over half of all respondents (56%) stated willingness to allow threatened or endangered birds to nest in their chimney before having attended one of the chimney swift programs (p 53, Table 8). None of the apparent changes in attitude (p 53, Table 8) were statistically significant (p 53, Table 9).

Table 8. Attitude responses in percentages for the pre-program survey and the post-program survey; where "Would Allow" indicates that respondents would allow a threatened or endangered bird species to use their chimney for nesting purposes, and "Would Not Allow" indicates the contrary.

Respondent Attitudes in Percentages			
		Response in Percentages	
Program Type	**Attitude**	**Pre-Program**	**Post-Program**
All Programs	Would Allow	56%	63%
	Would Not Allow	23%	17%
Café	Would Allow	61%	64%
	Would Not Allow	18%	18%
Talk	Would Allow	48%	55%
	Would Not Allow	24%	20%
Walk	Would Allow	69%	80%
	Would Not Allow	12%	11%

Table 9. Global null hypothesis test; table shows that our attitude model was not significant; where DF is the degrees of freedom and Pr > ChiSq is the p-value (greater than 0.05).

Testing Global Null Hypothesis: BETA = 0				
Variable	**Test**	**Chi-Square**	**DF**	**Pr > ChiSq**
Attitude	Likelihood Ratio	8.483	5	0.13

Although the average chimney swift program attendee indicated, after experiencing the program, that they would allow a threatened or endangered bird to use their chimney for nesting purposes, the average attendee also indicated that they intended to leave their chimney in its current capping state. Approximately 12% of respondents with capped chimneys indicated they intended to uncap their chimneys and 17% intended to leave their uncapped chimneys uncapped (p 54, Table 10). Nearly 25% of respondents with capped

Table 10. Summary of chimney status, chimney cap status, and intended action (behavior) responses; where n = number of respondents.

		All Respondents	Science Café	Swift Talks	Swift Walks
Chimney Status	n	254	35	149	70
	Suitable nesting chimney	54%	49%	50%	66%
	Unsuitable chimney	42%	46%	46%	33%
	Unsure	4%	6%	5%	1%
Cap Status	n	159	19	88	52
	Capped	61%	53%	67%	54%
	Uncapped	21%	26%	14%	33%
	Unsure	18%	21%	19%	13%
Intended Action (Behavior)	n	115	15	62	38
	Cap	1%	0%	2%	0%
	Leave Capped	45%	47%	47%	42%
	Uncap	17%	7%	21%	16%
	Leave Uncapped	24%	20%	19%	34%
	Unsure	12%	27%	11%	8%

chimneys said they would leave them capped. Only one person with an uncapped chimney indicated that s/he would be capping their chimney; however, this person indicated that they already had plans to cap their chimney before the program because “a woodpecker destroyed the top.”

Approximately 27% of respondents who provided their home addresses for follow-up observations did not provide an intended action for their chimney cap status.

Behavior.

Ninety-three survey respondents provided their home address for follow-up chimney observations. Fourteen of the 15 respondents who indicated that they would uncap their chimneys for nesting purposes still had capped chimneys three months after experiencing their chimney swift program. The remaining respondent who indicated that s/he would uncap was unobservable, as the home is located within a gated community, and we could not gain entry or otherwise contact the respondent. Six respondents out of the 21 (approximately 29%) who intended to leave their chimneys uncapped for nesting purposes still had uncapped chimneys three months after experiencing a chimney swift program. The remaining 15 respondents were either incorrect about their chimney's cap status or decided to cap their chimney after attending a chimney swift program, as follow-up observations found that these respondents' chimneys were capped. For example, one respondent, who indicated that they had a suitable nesting chimney but was unsure of their cap status and did not provide an intended action, actually owned an unsuitable chimney. All of the respondents who indicated that they would leave their chimneys capped had capped chimneys. The one survey respondent who intended to cap his chimney (due to previous woodpecker damage) had done so within three months of experiencing a chimney swift program.

Educational Brochure Study

There was no change in the chimney status among the 600 homes that received an educational brochure; no capped chimneys were uncapped and no uncapped chimneys were capped.

DISCUSSION

Overall, the Wake Audubon presentations increased knowledge but did not significantly change the attitudes or behaviors of those who attended them. We did not evaluate changes in knowledge or attitude as a result of educational brochure distribution. However, the campaign failed to elicit any measurable behavioral changes – no chimneys were uncapped. On the positive side, none of the respondents with uncapped chimneys indicated on their post-program survey that they would cap them as a result of the chimney swift information they received from the Wake Audubon programs.

Dated literature about pro-environmental attitudes and behaviors suggests that positive attitude and behavioral change can occur when individuals experience an increase in knowledge and awareness of an issue and gain the knowledge of alternatives, action strategies, or skills necessary to participate in pro-environmental actions (or cease environmentally harmful actions) (Hines et al., 1986). More recent studies have concluded, however, that too many extraneous contributing factors usually interfere with an individual's decision to change a behavior to determine that pro-environmental behavior is a direct result of increased knowledge and awareness (Lorenzoni et al., 2007 and Boyes & Stanistreet, 2012). These contributing factors may be personal (e.g., competing motives, activity levels, and other attitudes) or situational (e.g., social norms, alternative options available, specificity of the behavior objective, unforeseen extraneous events, and expected or actual consequences of the behavior).

Was Wake Audubon reaching the right target audience – owners of homes with suitable nesting chimneys?

Slightly more than half the audience members at Wake Audubon's presentations were in a position to benefit chimney swifts by appropriate management of their chimneys. We do not know whether the respondents owned or rented their homes, which could affect their ability to uncap chimneys – renters have less control over such things. Those who were present, however, were well-educated, affluent, and sympathetic – the kinds of people environmental groups consider most likely to act favorably toward the environment.

Did the educational presentations about chimney swifts increase the knowledge or change the attitude of those who attended?

Wake Audubon's presentations increased knowledge significantly but did not significantly change the attitude of audience members. Both are considered important steps toward behavioral change. For our study, we have no way of knowing how long-lasting the effects of the new chimney swift awareness, knowledge, and pro-conservation attitudes will last.

Did the presentations or mass-distributed educational brochures change the behavior of those who received them – did they uncap their chimneys?

We observed no behavioral changes during the study. One possible explanation is that the brochures either failed to reach or were not read by the person able to make decisions about the chimney, including situations in which residents are renting the home.

This seems an unlikely explanation for total failure and, in fact, our result is not surprising according to literature covering behavior change, as intent and overt behavior can differ greatly (Downing & Ballantyne, 2007). The literature on attitudes suggests, however, that the extensively studied "attitude concept" – that changed attitude leads to changed behavior – may have inadvertently led to failures in environmental and conservation education programs when program creators tend to focus on changing attitudes rather than providing people with the skills to change behavior. Personal and situational factors can influence the attitude-behavior relationship, and often attitude is completely unrelated to actual behavior (Wicker, 1969 and 1971). The best predictor of behavior, in fact, may not be knowledge or attitude, but rather the interaction between a general feeling of benefitting the environment weighed against personal incentives, disincentives, and concerns (Boyes & Stanisstreet, 2012). We allowed three months before looking for behavioral change, a time period we felt reasonable for follow-through with stated intent to uncap. It is possible that some homeowners changed their behavior after we concluded our study.

A few anecdotal observations during our study further support Wicker's (1969) notion that personal and situational factors – including competing motives, past experience, unforeseen extraneous events, and consequences of the behavior change – largely influence the adoption of a behavior change. During post-brochure distribution observations, one homeowner commented that due to the age of the homes in the area, combined with the surrounding forested areas, capping was necessary to protect chimney construction and the home from damage by weather and unwelcome wildlife because the homes were old and the area forested. Another homeowner confessed that had Wake Audubon proposed uncapping his chimney for an endangered species or a national icon, like a bald eagle, he may have considered it. Yet another homeowner declared that she had specifically capped her chimney to deter wildlife, as she had experienced previous “sad” discoveries of “dead birds” trapped in her chimney.

Did knowledge, attitude, or behavior change vary among socioeconomic groups?

Because demographic survey data for the educational programs were quite uniform, we did not statistically compare knowledge or attitude changes between demographic variables. Measurable behavior change was not observed for either study, so we could not compare behavior change among the income brackets used for the brochure study.

We did not ask respondents to compare their willingness to uncap their chimney as a method of chimney swift conservation to other potential alternatives, such as purchasing or building a nesting tower, or participating in an incentive program to uncap only during the nesting season. The potential risk to personal property, the perceived physical effort, or the financial disincentive of removing their homes’ chimney caps may have been more of an influence on our respondents’ decisions than the idea of participating in a pro-conservational action for chimney swifts in general. While there is some disagreement in the literature about the influence of economic orientation on behavior change, recent literature suggests that situational influences, including economic concern, may dominate a decision, even if there is a strong believed effectiveness of an action and a willingness to act (Boyes & Stanisstreet, 2012).

CONCLUSION

We conclude that mass-distributed educational material was an ineffective way to influence pro-conservation behavior of uncapping for chimney swifts; however we cannot extrapolate to mass-distributed educational material in general. More research must be done on the effects that educational material alone has on behavior change and the perceived financial disincentives of behavior change.

We can conclude that Wake Audubon achieved their goal of raising chimney swift awareness and knowledge in their audience members, although the organization did not set specific, quantifiable goals for that increase.

Wake Audubon's goal of convincing program attendees to uncap their chimneys for chimney swift nesting purposes was not met. Chimney cap removal is a very rare event, especially when most chimney caps are installed to protect personal property. To have a greater effect on the local chimney swift population, Wake Audubon may have to re-focus its efforts away from education and focus more on removing the impediments to behavior change, some of which are financial, and reducing the risk of uncapping. The organization could raise money to design a swift-friendly chimney cap, pay for an annual cap removal and reinstallation program, sponsor or develop an artificial chimney producer or organization, or fund research for specific species or conservation issues, like the decline in chimney swift nesting habitat.

If chimney swift programs are to be continued, and for future conservation campaigns, we suggest that Wake Audubon will be more successful in its campaign goals if the organization were to use more organized and specific program planning, implementation, and evaluation techniques (e.g., Jacobson et al. 2006) to design and carry out its educational programs.

CHAPTER 3: CHIMNEY SWIFT PROGRAM EVALUATION: RECOMMENDATIONS FOR WAKE AUDUBON

In Chapter 1 we suggest the use of a structured set of guidelines for the development of successful environmental education programs. Specifically, the Planning-Implementation-Evaluation (PIE) process suggested by Jacobsen et al. (2006) is meant to help conservation educators avoid common program problems such as disorganized use of organization resources or creating negative program "side effects." In this chapter we will assess the planning, implementation, and evaluation methods executed by Wake Audubon for their "Year of the Chimney Swift" campaign programs.

Post-study period interviews were held with Wake Audubon's main educator and presenter, John Connors, and the organization's Treasurer and Science Café co-presenter, John Gerwin. Planning and implementation flaws were discussed that help reveal potential causes of some of the failures of the chimney swift programs.

Planning.

According to Jacobsen et al. (2006), educators should answer the following questions when planning an educational program:

- "What is the conservation problem or issue you want to address?
- What are your goals and objectives?
- What messages must be sent?

- What channels and activities will most efficiently result in the desired changes in knowledge, attitudes, or behaviors?
- What audiences or stakeholders are involved in the issues to be communicated?
- What are their backgrounds, needs, interests, and actions?
- For each audience, what changes or actions are desired?
- How can audience members be involved in the planning process?
- What constraints and resources are there?"

To address the issue of the decline in the chimney swift population, Wake Audubon chose the species as its "Bird of the Year" for two years in a row. Members identified three goals for the chimney swift campaign:

- Raise funds for a chimney swift research chimney;
- Educate the public about chimney swifts and raise awareness about the chimney swift's population decline;
- Convince people to uncap their chimneys for chimney swift nesting purposes.

The objectives for these goals were:

- Talk about the chimney swift research tower during programs in an effort to gain monetary support for the construction project;

- Distribute "Buy a Brick for Swifts" brochures after every program and mail them to the Wake Audubon mailing list;
- Host various forms of educational programs in order to raise awareness about the chimney swift's population decline;
- Provide alternatives to capping and the skills required to rid of mammal species in chimneys in program language to convince people to uncap.

According to Jacobsen et al. (2006), these objectives could have been more "S-M-A-R-T"- *Specific, Measurable, Audience-focused, Relevant,* and *Time-limited.* Talking about the research tower and fundraising were indeed specific objectives with an outcome that could be observed coming into Wake Audubon's project account. The distribution of "Buy a Brick" brochures was another specific objective of the organization. Aside from this study's survey, however, Wake Audubon did not designate specific knowledge and awareness questions it thought important for its audience to understand except for the fact that the chimney swift population is declining. The behavior or outcome that was ultimately desired, the uncapping of chimneys, would have been specific - an observable action in the community had it occurred, but only because Wake Audubon commissioned this study to do so. The monitoring of chimneys in the area both before and after programs is a time-consuming process that would ideally require many resources (such as gas money for volunteers) and much coordination and planning between multiple members for the organization.

None of the objectives were measurable- they did not provide quantifiable indicators of progress toward achieving the objectives. The organization had a minimum goal of $35,000 for the construction of the chimney swift tower, but it did not designate how much money they hoped to collect from program attendees, Wake Audubon members, grants, and other donors apiece. Aside from this study's survey Wake Audubon did not devise any other means to gauge whether its programs improved chimney swift knowledge or awareness in its audience members.

Wake Audubon was not audience-focused during the development of its programs. Programs were not developed with a specific target audience in mind. Similarly, the organization did not target specific audiences, such as communities with 100% capped but suitable nesting chimneys. Half (approximately 54%) of Wake Audubon's total audience had suitable nesting chimneys.

Talking about the research tower and distributing "Buy a Brick" brochures were relevant objectives for fundraising. Hosting educational programs to increase knowledge and awareness in audience members was also a relevant objective for the campaign, however the programs were not consistent in knowledge change. Again, the objective to convince people to uncap for nesting purposes was not relevant for approximately half of Wake Audubon's total audience. According to the literature, providing knowledge and the skills required to implement alternatives to capping was a relevant objective for the educational programs (Ramsey et al., 1981, Hines et al., 1986, Braus, 1995, Jacobsen et al., 2006, & Monroe, 2010).

Specific time frames for the campaign objectives were not set. Fundraising did not have a set time frame; it is assumed that Wake Audubon would continue fundraising until construction could be completed. The time frame for the educational programs was assumed to be throughout the "Year of the Chimney Swift" campaign; however Connors has conducted chimney swift programs in past years during other "Bird of the Year" campaigns and will continue to do so at least once a year, every September, during roosting season in Raleigh, NC.

Implementation.

For implementation of a successful program, Jacobsen et al. (2006) suggest that educators consider the following:

- "What modifications are indicated by pilot tests of activities and materials?
- Is scheduling, funding, and staffing adequate and efficient?"

Pilot tests, conducted before a program is implemented fully, can help ensure that the objectives and planned activities are effective and allow the program designers to make necessary changes before implementing a potentially costly program that will inevitably fail. A pilot test of this study's survey was conducted and modified according to respondent suggestions. However, Wake Audubon did not conduct a pilot test of any of its programs to determine if campaign goals and program objectives were relevant for its audiences.

Jacobsen et al. (2006) suggest that during the actual implementation of a conservation program, a final schedule, budget, and formalization of program educator responsibilities should be established, along with a system for monitoring program operations and evaluating program results. Both Connors and Gerwin believed that a severe lack of organization for the actual implementation of the programs created some major inefficiencies and failures of the campaign.

Both individuals felt that the "Year of the Chimney Swift" campaign could have been improved had Wake Audubon waited to launch the campaign until after the NC Museum of Natural Science's Nature Research Center was constructed. Funding and staffing from Wake Audubon's partner organization, Friends of the Museum, were tied up in the completion of that project at the time of the chimney swift campaign's conception (Connors, personal communication, 5 October 2012 & Gerwin, personal communication, 5 October 2012). Gerwin mentioned that he felt that the campaign may have been more successful had Wake Audubon been able to hire additional part-time educators to conduct programs. He declared that one to two people conducting all the research and educational programs per campaign leads to educator "burn out" and frustration (Gerwin, personal communication, 5 October 2012). Similarly, Connors cited misgivings with staffing, funding, and timing. He would like to see Wake Audubon hire contract grant-writers or establish a grant committee. He said that members, like himself, who had no experience with grant applications completed the grant writing, and that although Wake Audubon's partnership with the Museum may have provided such a person, the Museum could not provide help at the time of the chimney swift campaign's planning and implementation period (Connors, personal communication, 5 October 2012).

Evaluation.

To evaluate a program for its effectiveness, Jacobsen et al. (2006) recommend educators answer the following:

- "How will you know if the strategy worked?
- What are the outputs and outcomes of the program?
- Have you assessed key indicators of success, such as changes in the environment or in audience knowledge levels, attitudes, or behaviors?
- Did the target audience receive the message?
- Were the materials recognized; was the message remembered?
- Was the audience interested, satisfied, or engaged with the activity?
- Are there changes in audience knowledge, attitude, or skills?
- Are there long-term changes in resources use or participant behavior, or increased concern for environmental management or conservation legislation?
- Are there improvements in the wildlife, ecosystem, or other conservation target?"

Wake Audubon commissioned this study to determine if its strategies worked, the ideal outcomes being knowledge, attitude, and behavior change (uncapping chimneys) in audience members. For future programs the organization will have had to devise its own method of measuring knowledge, attitude, and behavior change. We determined that there was an increase in knowledge for all program types, but no significant changes in attitude or behavior. There will likely be no major improvement in the conservation target, chimney swifts, as a direct result of Wake Audubon's educational programs

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Connors believes that the target audience received the "message"- the materials were recognized and the "message" was remembered. He feels that the programs provided information and knowledge to the community. The statistical analysis of the knowledge and attitude questions in the survey and the chimney observations support his belief that program attendees left chimney swift programs knowing more about chimney swifts than when they arrived, but not necessarily with a changed attitude towards chimney-nesting birds or intent to change their behavior. Connors believes he personally reached at least 3,000 to 4,000 people in Wake County and throughout the state with chimney swift awareness and knowledge, especially after a local newspaper article was published that followed one reporter's experience with a chimney swift program attendee.

Wake Audubon should now have a better understanding of the demographic characteristics and the bird conservation attitudes it typically attracts for audience members, whether deliberately or unintentionally. Specifically for the chimney swift programs, about half of

Wake Audubon's audience had the potential to influence chimney swift conservation directly by uncapping a chimney. Most of them were unwilling to do so, even though the audience members were relatively pro-environment (as it is assumed they would not attend such a program if they were not), generally well-educated and, judging by their socioeconomic status, able to pay for a chimney cap removal.

In this chapter we compared Wake Audubon's methods to the Planning-Implementation-Evaluation (PIE) process suggested by Jacobsen et al. (2006). The instrument that is used is not as important as the idea of having a set of guidelines by which to develop programs consistently and assess an organization's resources and abilities to achieve its goals and objectives. Wake Audubon did not significantly change the attitudes or behavior of its audience with regard to uncapping chimneys for chimney swift nesting purposes. The organization did successfully increase chimney swift knowledge and awareness in its audience members. This study should provide Wake Audubon with a good understanding of its current program development methodology and an awareness of its average audience. Ideally, Wake Audubon will use this data to better plan, implement, and evaluate its programs and attempt to target more specific audiences, determined by its goals and objectives.

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APPENDICES

APPENDIX A: EDUCATIONAL BROCHURE

SWIFT FACTS ABOUT CHIMNEY SWIFTS

- Chimney swifts do not stop flying all day long — they can fly up to 20 mph and may travel up to 320 miles per day.
- Chimney swifts cannot land, perch, walk, or hop — they must cling to vertical surfaces.
- They spend their springs and summers everywhere east of the Rocky Mountains, and migrate to South America for fall and winter.
- Chimney swifts are monogamous — you may have the same pair of nesting swifts in your chimney every year for up to 8 years!
- Nests are built with twigs the birds break from the tips of trees (midflight!) and held together by their own saliva.
- Only one pair of birds will nest in your home chimney, but lots of chimney swifts will roost together in large industrial chimneys in your nearest urban area. You can watch as up to thousands of birds cyclone into a downtown (or old-school chimney) every night in September!

JOHN CONNORS

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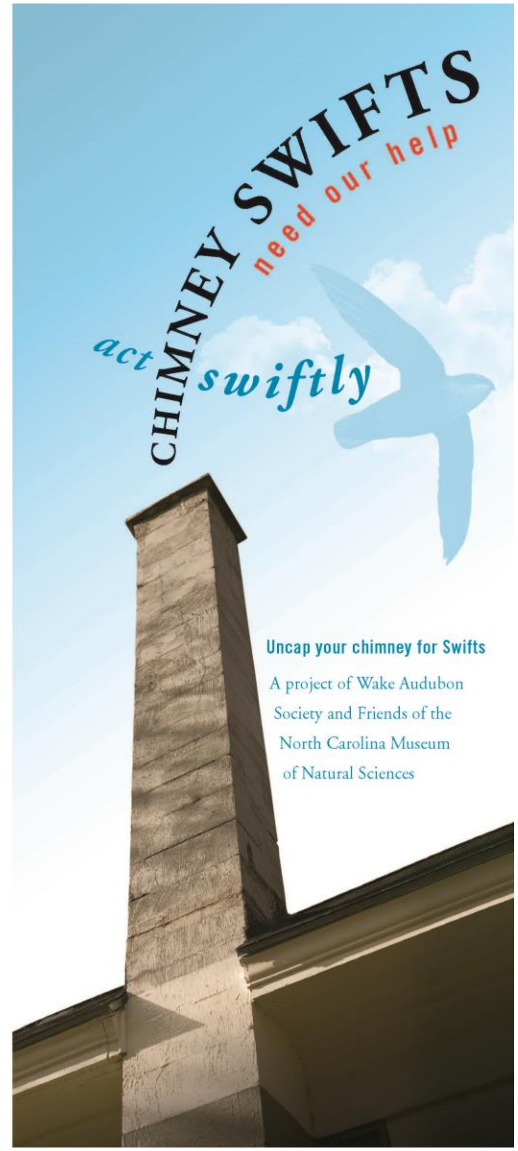


DERRICK HAMRICK

THOUSANDS OF SWIFTS GO TO ROOST AT TWILIGHT EVERY NIGHT FROM AUGUST THROUGH SEPTEMBER IN LARGE INDUSTRIAL CHIMNEYS, BUT ONLY ONE PAIR OF BIRDS WILL NEST IN YOUR CHIMNEY FROM APRIL TO JULY.

CHIMNEY SWIFTS

For more than 200 years chimney swifts have tied their fate to ours by using chimneys for nesting and roosting. In return, they consume great numbers of flying insects. It's been a successful partnership. But swift populations are declining due, in part, to a shortage of available chimneys.

Chimney swifts need our help.

Wake Audubon Society and Friends of the Museum are partnering to educate the public about the plight of the chimney swift. Seven percent of the chimneys in the Triangle area are capped each year, resulting in a gradual decline of the chimney swift population. Over the next 20 years, the chimney swift population will decline by 60 percent if capping rates remain the same.

UNCAP YOUR CHIMNEY FOR SWIFTS

When you uncap your chimney, or commit to leaving your chimney uncapped, you will contribute to the preservation of a species that long ago chose to cling to humanity rather than perish.

JOHN CONNORS

Alternatives to capping your chimney:

Uncap your chimney for nesting season in mid-March, replace cap in September.

A mason jar filled with ¼ inch of ammonia and cotton balls placed in your chimney will cause any pest mammals in your chimney to leave within minutes.

Pigeon spikes placed around the rim and outside edge of your chimney will deter other birds and mammals from entering your chimney — chimney swifts cannot perch on surfaces and will not be harmed.

A foam cut-out will muffle the sounds of nesting chimney swifts. REMOVE BEFORE USING CHIMNEY.

BIRDS IN MY CHIMNEY?

- If you hear chirping or chittering inside your chimney between April and July, you may have chimney swifts.
- Chimneys made of stone, brick or masonry flue tiles with mortared joints provide the right surfaces for nesting chimney swifts.
- Unlike creosote buildup, swift nests in chimneys do not cause a fire hazard — chimneys should be cleaned in mid-March or after the wood-burning season ends and before the swift nesting period begins. (This is standard wood-burning chimney maintenance.)
- Dampers should be inspected and remain closed during the nesting season to prevent birds from flying into the house and becoming trapped or injured — should a baby bird falls into your fire place, sticking it to the inside wall of the chimney will allow it to climb back up on its own!)
- Chimney swifts are protected by the **Migratory Bird Treaty Act** and a federal permit is needed to remove birds and their nests during the nesting season.

For more information about chimney swifts:

Contact us at ***wakeaudubon.org***
Also ***swift.sepif.org***

APPENDIX B: NCSU INSTITUTIONAL REVIEW BOARD EXEMPTION APPROVAL LETTERS

North Carolina State University is a land-grant university and a constituent institution of the University of North Carolina

Office of Research and Innovation
Division of Research Administration

NC STATE UNIVERSITY

Campus Box 7514
Raleigh, North Carolina 27695-7514

919.515.2444 (phone)
919.515.7721 (fax)

From: Carol Mickelson, IRB Coordinator
North Carolina State University
Institutional Review Board

Date: May 19, 2011

Title: Effectiveness of a local environmental organization's educational methods on environmental behavior change

IRB#: 2049

Dear Ms. Lobsinger,

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101. b.2). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review.

NOTE:

1. This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU projects, the Assurance Number is: FWA00003429.

2. Any changes to the research must be submitted and approved by the IRB prior to implementation.

3. If any unanticipated problems occur, they must be reported to the IRB office within 5 business days.

Please forward a copy of this letter to your faculty sponsor, if applicable. Thank you.

Sincerely,

Carol Mickelson

Carol Mickelson
NC State IRB

North Carolina State University is a land-grant university and a constituent institution of the University of North Carolina

Office of Research and Innovation
Division of Research Administration

NC STATE UNIVERSITY

Campus Box 7514
Raleigh, North Carolina 27695-7514

919.515.8754 (phone)
919.515.7721 (fax)

From: Jennifer Ofstein, IRB Coordinator
North Carolina State University
Institutional Review Board

Date: February 18, 2013

Title: Effectiveness of a local environmental organization's educational methods on environmental behavior change

IRB#: 2049

Dear Meghan,

Your addendum to the study named above has been reviewed by the IRB office, and has been approved. Revision includes: permission to talk to educational brochure recipients to address potential uncertainties. The addendum does not change the original IRB exemption status of this project and you are free to proceed with your study.

If you have any questions please do not hesitate to contact the IRB office at 919.515.4514.

Sincerely,

Jennifer Ofstein

Jennifer Ofstein
NC State IRB

APPENDIX C: PRE/POST CHIMNEY SWIFT PROGRAM SURVEY

North Carolina State University
INFORMED CONSENT FORM for RESEARCH

Title of Study: *Effectiveness of a local environmental organization's educational methods on environmental behavior change*

Principal Investigator: Meghan Lobsinger

Faculty Sponsor: Dr. George Hess

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time without penalty. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher(s) named above.

What is the purpose of this study?
The survey that you are being asked to participate in is part of a larger study that will attempt to answer the question, "Are the measures typically used by conservation organizations effective in reaching these organizations' goals?" Wake Audubon's Year of the Chimney Swift programs are being used as the case study for this research project. To answer this question, the principal investigator will attempt to discover whether Wake Audubon is reaching the public that will have the most effect on chimney swift conservation (those homeowners with potential chimney swift breeding chimneys) through its outreach efforts. If the organization is indeed reaching the desired public, do its educational methods influence those people to change their behavior? Today's survey will attempt to answer these questions by addressing the audience and analyzing the success of Wake Audubon's chimney swift presentation, a common method of environmental education outreach.

What will happen if you take part in the study?
If you agree to participate in this study, you will be asked to sign the Informed Consent Form for Research before beginning the pre-presentation survey. You will then be asked to fill out a pre-presentation survey before hearing Wake Audubon's chimney swift presentation. This survey should only take 5-10 minutes. The pre-presentation survey will ask that you wait to fill out the post-presentation survey (attached) until after Wake Audubon has completed its presentation. After the presentation, you will be prompted to complete the post-presentation survey and return the whole survey packet to the survey proctor (either the principal or an associated investigator). The post-presentation survey should only take 5-10 minutes. The completed surveys, collected by the survey proctor, will then remain locked in the principal investigator's filing cabinet at North Carolina State University when not undergoing analysis. Should you have chosen to participate in the follow-up, non-invasive observational study by providing your contact information, you *may* be contacted up to six months after participating in the survey by the principal investigator.

Risks
There are no foreseeable risks associated with participating in this study. Potential discomfort for some subjects may result from the request for subject contact information and the demographics survey questions. The main purpose of this Informed Consent form is to remind subjects that their participation in this study is voluntary, and that they may choose not to participate or stop participating at any time without penalty. Subjects will NOT be asked to provide their names with their contact information. Participants will be asked for their home address and other contact info, which will be coded with a unique ID for computer files. The IDs will then be held in an encrypted file accessible only to the principal investigator and associated committee members. For more information, please reference the Confidentiality section of this Informed Consent Form below.

Benefits
There is no direct benefit expected for the subject. However, by participating in this study, subjects will help to provide knowledge about the success of Wake Audubon's outreach efforts, the public it is reaching with these efforts, and whether the organization is achieving its organizational goals. This study may then provide an example for other environmental organizations to assess the success of their own programs, and consequently make more efficient resource allocation decisions.

Confidentiality
The information in the study records will be kept confidential to the full extent allowed by law. Data will be stored securely in a locked filing cabinet drawer of the principle investigator's faculty sponsor. No reference will be made in oral or written reports which could link you to the study. Even should you choose to provide your contact information for the follow-up observational study, you will NOT be asked to write your name on any study materials so that no one can match your identity to the answers that you provide. Participants will be asked for their home address and other contact info, which will be coded with a unique ID for computer files. The IDs will then be held in an encrypted file accessible only to the principal investigator and associated committee members.

Compensation
You will not receive anything for participating in this study.

What if you are a NCSU student?
Participation in this study is not a course requirement and your participation or lack thereof, will not affect your class standing or grades at NC State.

What if you are a NCSU employee?
Participation in this study is not a requirement of your employment at NCSU, and your participation or lack thereof, will not affect your job.

What if you have questions about this study?
If you have questions at any time about the study or the procedures, you may contact the researcher, Meghan Lobsinger, at MELOBSIN@ncsu.edu, or 919-961-7559.

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Deb Paxton, Regulatory Compliance Administrator, Box 7514, NCSU Campus (919/515-4514).

Consent To Participate
"I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may choose not to participate or to stop participating at any time without penalty or loss of benefits to which I am otherwise entitled."

Subject's signature______________________________ **Date** ______________

Investigator's signature Meghan E. Lobsinger **Date** 12 September 2011

Pre-Presentation Survey

The following surveys are part of a graduate student research study to evaluate approaches to conservation education. Please fill out the pre-presentation survey as you wait for today's chimney swift presentation to begin. Fill out the post-presentation survey ***AFTER*** you have heard today's presentation. ***Your name and contact information will remain confidential.*** Your participation is greatly appreciated! Thank you for your time.

1. How many times have you attended these Wake Audubon-sponsored chimney swift events, *EXCLUDING* this time? Please check the appropriate box for each event type.

	None	1-2	3-4	> 4
Chimney swift walk (roost site visit/tour)				
PowerPoint presentation about chimney swifts				
NC Museum of Natural Sciences Science Café about chimney swifts				
A chimney swift event or presentation held by another organization or group				
Other (Please Explain):				

Have you filled out this survey before? [ ] Yes [ ] No [ ] Unsure

2. Please circle *ONE* response for each of the following questions:

Question	Responses		
Chimney swift populations have ___________ since the 1970s.	Increased	Decreased	Remained the same
Chimney swifts cannot ___________.	Perch	Fly	Make noises
Chimney swifts migrate between North America and ___________.	Africa	South America	Europe
Chimney swifts will only nest in your chimney between ________ and ________.	April/July	Aug/Dec	Jan/March
How many pairs of chimney swifts will **nest** in your chimney at one time?	Up to 20 pairs	Up to 5 pairs	1 pair

3. If you knew that a bird species that is disappearing from North Carolina could use your chimney as a nesting site, regardless of what kind of chimney you have, would you allow that species access to your chimney? Please check *ONE* response.

[ ] Yes [ ] No [ ] Unsure

Please explain why you chose this response: ___________________________________

____

Please answer the following questions concerning your home's chimney:

4. Do you live in a home with at least one chimney constructed of brick, stone, or other masonry? Please check *ONE* response and follow the instructions associated with your response.

[ ] No
Please skip to question 8 on the next page.

[ ] Unsure [ ] Yes
Please continue to question 5.

5. Is your chimney capped? Please check *ONE* response and follow the instructions.

[ ] No [ ] Unsure
Please skip to question 7 below.

[ ] Yes
Please continue to question 6.

6. Do you know why your chimney is capped? Please check *ALL* that apply.

[ ] Unsure

[ ] Yes, it was like that when I moved in

[ ] Yes, a chimney specialist recommended that I have it capped

[ ] Yes, I had it capped to keep out the weather/elements

[ ] Yes, I had it capped to keep wildlife out (*Please indicate what kind of wildlife*:

____)

[ ] Yes, Other (*Please explain*: ______________________________________

____)

7. If you answered "Yes" or "Unsure" to question 4 and are willing to further significantly aid this study by participating in a follow-up study, please provide your contact information below. *You will not have to be contacted or surveyed again for the follow-up study.* Your participation is greatly appreciated!

Address: ____
Street Address City State Zip

Phone: ______________________ Email: ______________________

The following questions will help us to better understand who Wake Audubon is reaching with their educational outreach efforts.

8. Please indicate your gender by checking your answer: [ ] **Male** [ ] **Female**

9. In what year were you born? ________________

10. What is your race/ethnicity? Please check *ALL* that apply.

[ ] White/Caucasian [ ] Black or African American [ ] Native American

[ ] Asian [ ] Native Hawaiian/Pacific Islander [ ] Hispanic or Latino

[ ] Other (please specify):____

11. What is the highest level of formal education that you have completed? Please check *ONE* response.

[ ] Primary school [ ] High school graduate or GED [ ] Vocational or trade school

[ ] Some college [ ] Associate degree (2 year degree) [ ] College graduate (Bachelor's or 4 year degree)

[ ] Graduate or professional degree

12. What was your gross household income (before taxes) in 2010? Please check *ONE* response.

[ ] Less than $20,000 [ ] $20,000 to $39,999 [ ] $40,000 to $59,999 [ ] $60,000 to $74,999 [ ] $75,000 or more

Please take the time to fill out the post-presentation survey *AFTER* today's presentation.
The post-presentation survey is very important for the success of this study.

Post-Presentation Survey

13. Please circle *ONE* response for each of the following questions:

Question	Reponses		
Chimney swift populations have ___________ since the 1970s.	Increased	Decreased	Remained the same
Chimney swifts cannot ___________.	Perch	Fly	Make noises
Chimney swifts migrate to/from North America to/from _______________.	Africa	South America	Europe
Chimney swifts only nest in your chimney between _________ and _______.	April/July	Aug/Dec	Jan/March
How many pairs of chimney swifts will nest in your chimney at one time?	Up to 20 pairs	Up to 5 pairs	1 pair

14. If you knew that a bird species that is disappearing from North Carolina could use your chimney as a nesting site, regardless of what kind of chimney you have, would you allow that species access to your chimney? Please check *ONE* response.

[ ] Yes [ ] No [ ] Unsure

Please explain why you chose this response: ______________________________

____

15. Please answer one of the following questions ONLY IF you indicated that you have a chimney constructed of either brick, stone, or some other masonry. Please check *ONE* response.

My chimney IS capped.
I will…

[ ] Leave it capped

[ ] Uncap it

My chimney IS NOT capped.
I will…

[ ] Leave it uncapped

[ ] Cap it

[ ] I am unsure of my chimney's cap status

Please explain why you chose this response: ______________________________

____

16. Please leave any comments, questions, or suggestions you have about today's presentation and survey.

Please hand this booklet to the survey proctor. Feel free to ask for or keep the COPY of the Informed Consent Form for your own records. If at any time, for any reason, you wish to have your survey removed from the study, please contact Meghan Lobsinger on the Informed Consent Form.

Thank you for your time and participation with regards to this survey. Your participation will help provide valuable feedback to Wake Audubon and similar conservation organizations about the effectiveness of their educational outreach efforts.

APPENDIX D: SAS CODE AND OUTPUT FOR KNOWLEDGE

Code:

```
title 'Logistic Regression for All Questions';
ods graphics on;
proc logistic data= sasuser.knowledge plots(only)=(effect oddsratio) ;
*where Question = '5';
class Before_After (param=ref ref='Before')
      Venue (param=effect);
        model Correct_num (event='1') = Venue Before_After
Venue*Before_After/
                  clodds=pl;

oddsratio Venue / at (Venue = all) cl=pl;
oddsratio Before_After / at (Before_After = all) cl=pl;
run;
```

Output:

Logistic Regression for All Questions

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.KNOWLEDGE
Response Variable	Correct_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	2590
Number of Observations Used	2323

Response Profile

Ordered Value	Correct_num	Total Frequency
1	0	382
2	1	1941

Probability modeled is Correct_num=1.

Note: 267 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information			
Class	**Value**	**Design Variables**	
Before_After	**After**	1	
	Before	0	
Venue	**Cafe**	1	0
	Talks	0	1
	Walks	-1	-1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	2078.593	1802.282
SC	2084.344	1836.786
-2 Log L	2076.593	1790.282

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	286.3111	5	<.0001
Score	249.8995	5	<.0001
Wald	169.4573	5	<.0001

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
Venue	2	10.9181	0.0043
Before_After	1	125.4129	<.0001
Before_After*Venue	2	15.2616	0.0005

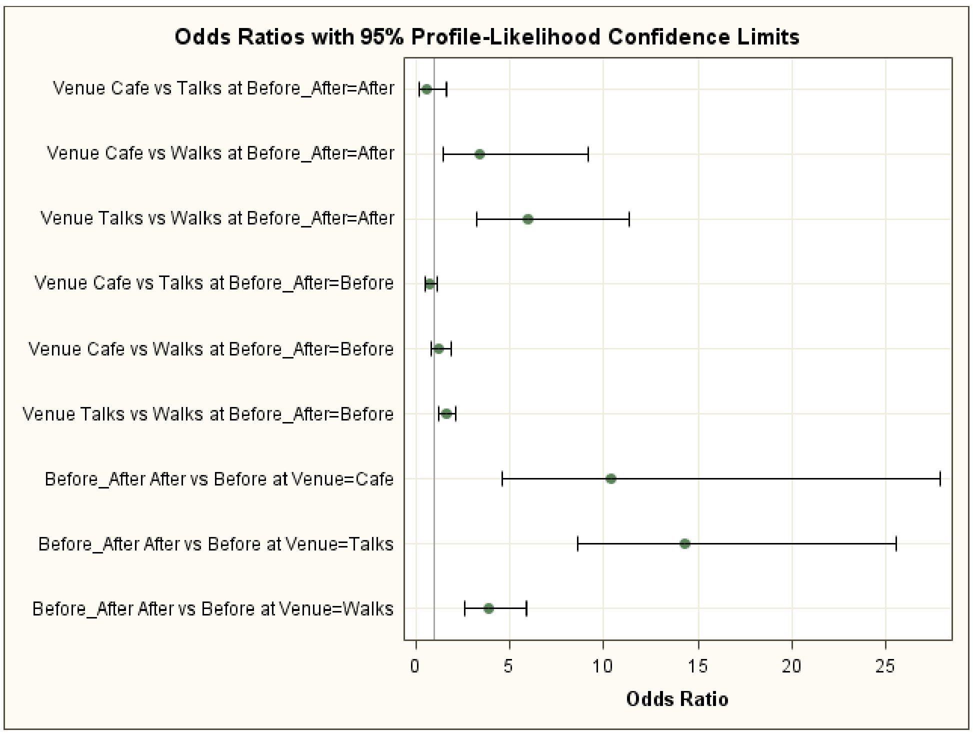
Analysis of Maximum Likelihood Estimates

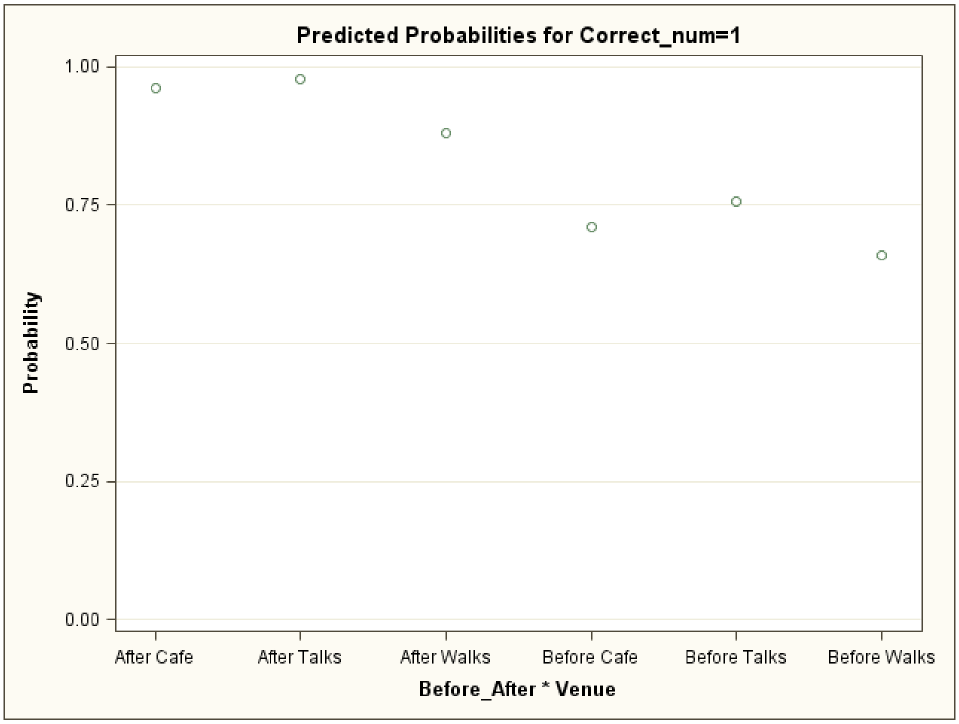
Parameter			DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept			1	0.8976	0.0747	144.4751	<.0001
Venue	**Cafe**		1	-0.00195	0.1231	0.0002	0.9874
Venue	**Talks**		1	0.2418	0.0913	7.0225	0.0080
Before_After	**After**		1	2.1189	0.1892	125.4129	<.0001
Before_After*Venue	**After**	**Cafe**	1	0.2241	0.3211	0.4871	0.4852
Before_After*Venue	**After**	**Talks**	1	0.5394	0.2475	4.7489	0.0293

Association of Predicted Probabilities and Observed Responses

Percent Concordant	65.6	**Somers' D**	0.491
Percent Discordant	16.5	**Gamma**	0.597
Percent Tied	17.9	**Tau-a**	0.135
Pairs	741462	**c**	0.745

Profile Likelihood Confidence Interval for Odds Ratios			
Label	**Estimate**	**95% Confidence Limits**	
Venue Cafe vs Talks at Before_After=After	0.572	0.228	1.625
Venue Cafe vs Walks at Before_After=After	3.406	1.509	9.139
Venue Talks vs Walks at Before_After=After	5.957	3.282	11.354
Venue Cafe vs Talks at Before_After=Before	0.784	0.540	1.149
Venue Cafe vs Walks at Before_After=Before	1.269	0.852	1.905
Venue Talks vs Walks at Before_After=Before	1.619	1.214	2.156
Before_After After vs Before at Venue=Cafe	10.412	4.645	27.865
Before_After After vs Before at Venue=Talks	14.272	8.584	25.561
Before_After After vs Before at Venue=Walks	3.878	2.595	5.908





Logistic Regression for Question 1

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.KNOWLEDGE
Response Variable	Correct_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	518
Number of Observations Used	461

Response Profile

Ordered Value	Correct_num	Total Frequency
1	0	28
2	1	433

Probability modeled is Correct_num=1.

Note: 57 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables	
Before_After	**After**	1	
	Before	0	
Venue	**Cafe**	1	0
	Talks	0	1
	Walks	-1	-1

Model Convergence Status

Quasi-complete separation of data points detected.

Warning:	The maximum likelihood estimate may not exist.
Warning:	The LOGISTIC procedure continues in spite of the above warning. Results shown are based on the last maximum likelihood iteration. Validity of the model fit is questionable.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	213.131	195.891
SC	217.264	220.691
-2 Log L	211.131	183.891

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	27.2398	5	<.0001
Score	22.9613	5	0.0003
Wald	11.8250	5	0.0373

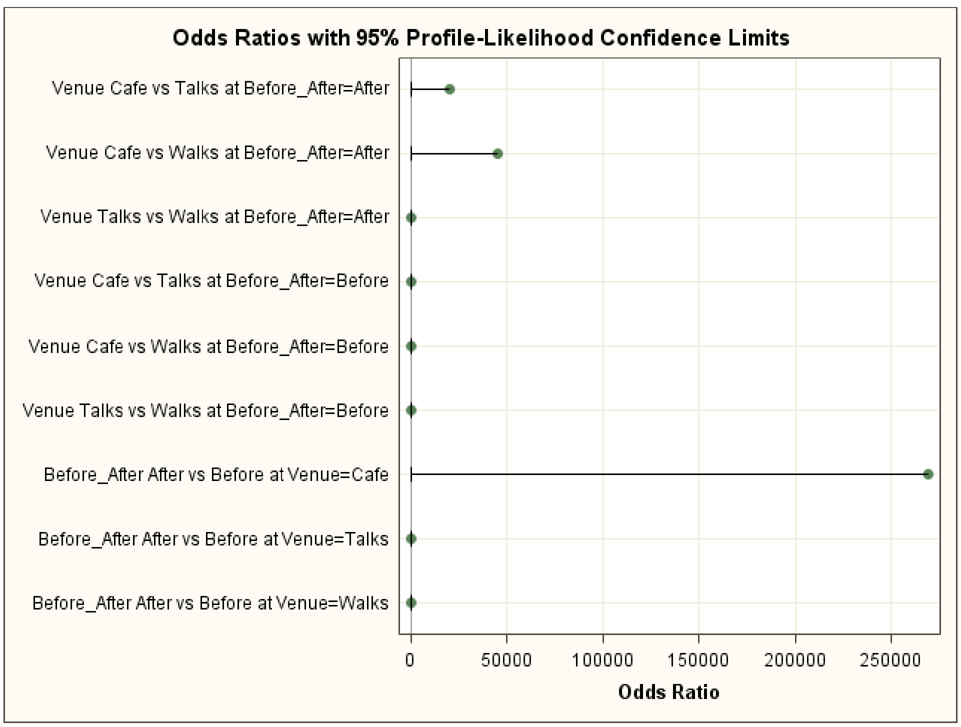
Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
Venue	2	0.4752	0.7885
Before_After	1	0.0035	0.9525
Before_After*Venue	2	0.1544	0.9257

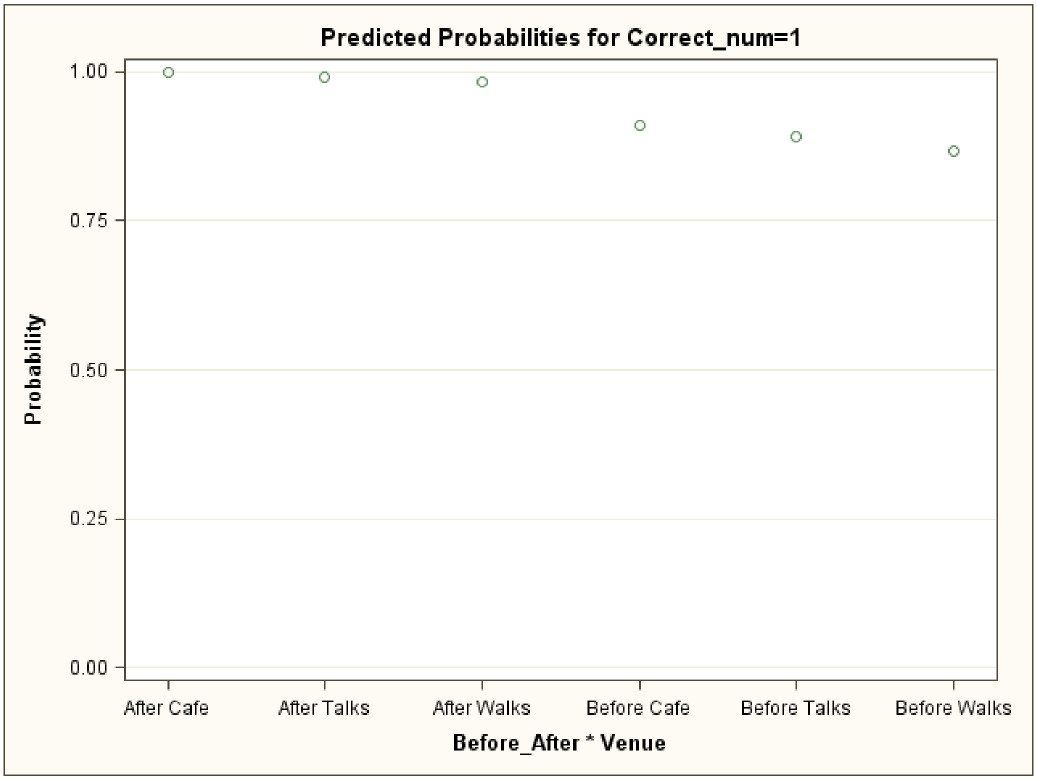
Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	2.1043	0.2525	69.4461	<.0001
Venue	**Cafe**		1	0.2311	0.4308	0.2877	0.5917
Venue	**Talks**		1	-0.00714	0.3008	0.0006	0.9811
Before_After	**After**		1	5.8496	98.2591	0.0035	0.9525
Before_After*Venue	**After**	**Cafe**	1	6.6532	196.5	0.0011	0.9730
Before_After*Venue	**After**	**Talks**	1	-3.0341	98.2609	0.0010	0.9754

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	65.1	**Somers' D**	0.501
Percent Discordant	15.0	**Gamma**	0.626
Percent Tied	19.9	**Tau-a**	0.057
Pairs	12124	**c**	0.751

Profile Likelihood Confidence Interval for Odds Ratios

Label	Estimate	95% Confidence Limits	
Venue Cafe vs Talks at Before_After=After	>999.999	0.040	.
Venue Cafe vs Walks at Before_After=After	>999.999	0.088	.
Venue Talks vs Walks at Before_After=After	2.230	0.087	56.950
Venue Cafe vs Talks at Before_After=Before	1.269	0.384	5.751
Venue Cafe vs Walks at Before_After=Before	1.576	0.434	7.486
Venue Talks vs Walks at Before_After=Before	1.242	0.491	3.003
Before_After After vs Before at Venue=Cafe	>999.999	1.101	.
Before_After After vs Before at Venue=Talks	16.702	3.281	304.813
Before_After After vs Before at Venue=Walks	9.305	1.672	174.248





Logistic Regression for Question 2

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.KNOWLEDGE
Response Variable	Correct_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	518
Number of Observations Used	458

Response Profile

Ordered Value	Correct_num	Total Frequency
1	0	48
2	1	410

Probability modeled is Correct_num=1.

Note: 60 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables	
Before_After	**After**	1	
	Before	0	
Venue	**Cafe**	1	0
	Talks	0	1
	Walks	-1	-1

Model Convergence Status

Quasi-complete separation of data points detected.

Warning: The maximum likelihood estimate may not exist.

Warning: The LOGISTIC procedure continues in spite of the above warning. Results shown are based on the last maximum likelihood iteration. Validity of the model fit is questionable.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	309.328	251.532
SC	313.455	276.294
-2 Log L	307.328	239.532

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	67.7955	5	<.0001
Score	52.8790	5	<.0001
Wald	6.1945	5	0.2877

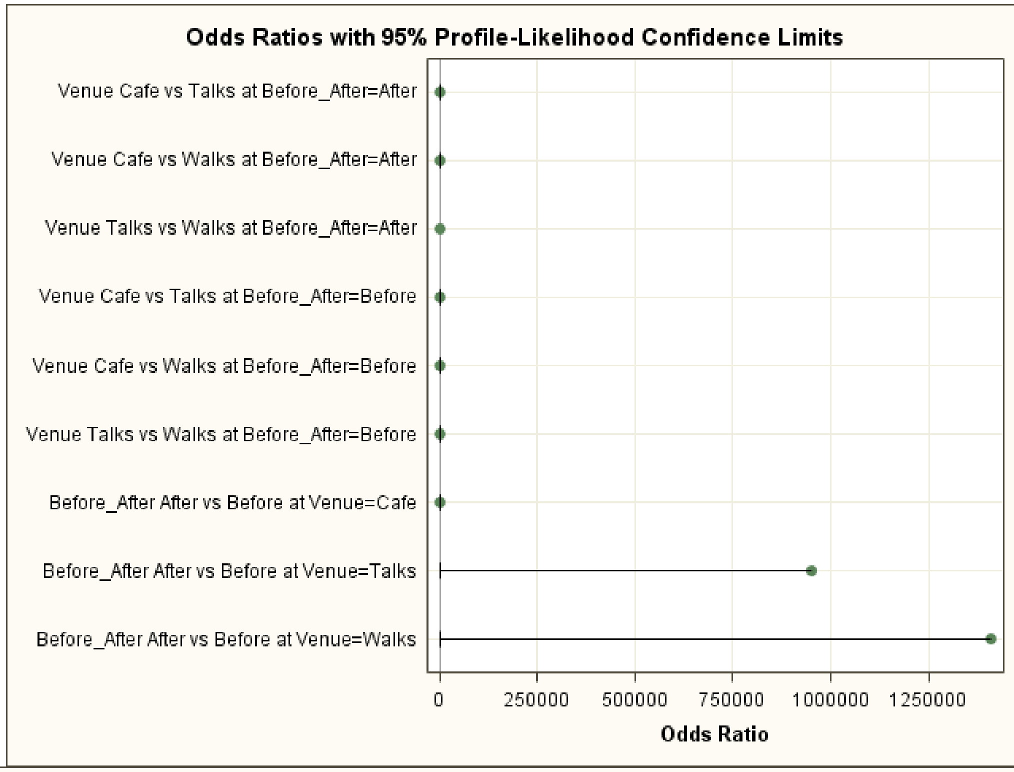
Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
Venue	2	1.9130	0.3842
Before_After	1	0.0088	0.9252
Before_After*Venue	2	0.0057	0.9972

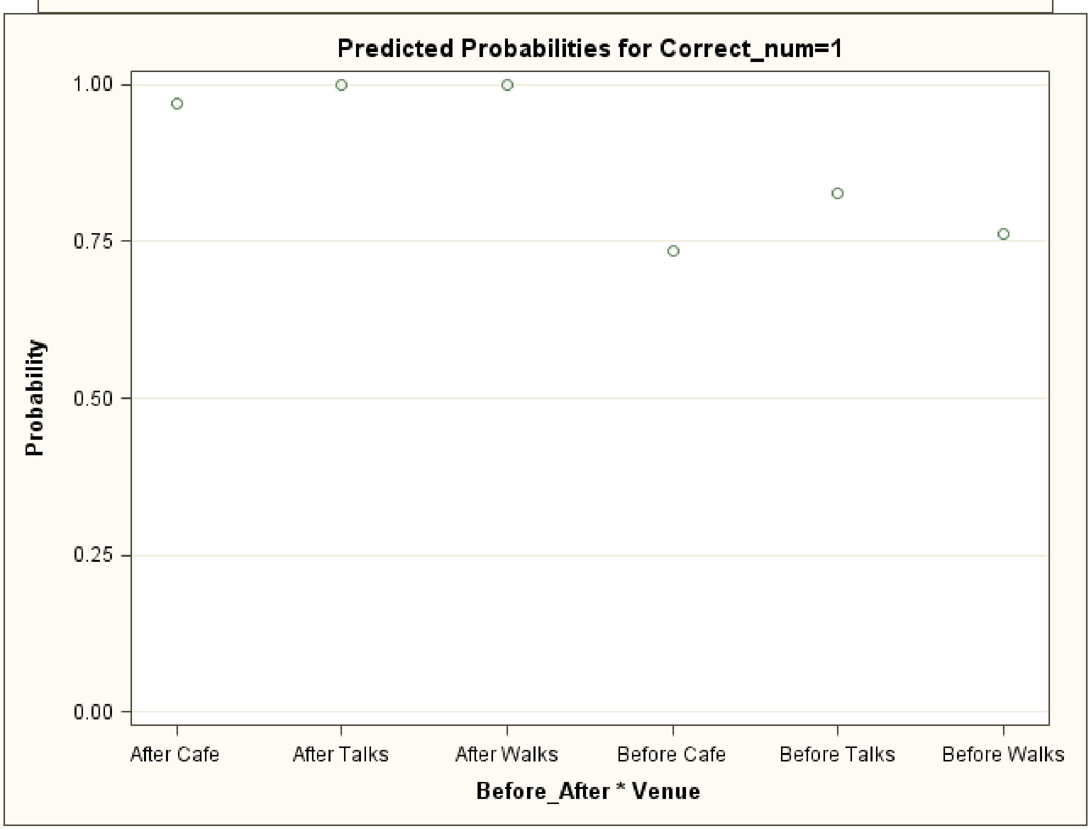
Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	1.2469	0.1799	48.0407	<.0001
Venue	**Cafe**		1	-0.2252	0.2876	0.6132	0.4336
Venue	**Talks**		1	0.3090	0.2234	1.9125	0.1667
Before_After	**After**		1	10.1228	107.8	0.0088	0.9252
Before_After*Venue	**After**	**Cafe**	1	-7.6787	107.8	0.0051	0.9432
Before_After*Venue	**After**	**Talks**	1	3.6430	151.7	0.0006	0.9808

Association of Predicted Probabilities and Observed Responses

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	70.9	**Somers' D**	0.596
Percent Discordant	11.4	**Gamma**	0.724
Percent Tied	17.7	**Tau-a**	0.112
Pairs	19680	**c**	0.798

Profile Likelihood Confidence Interval for Odds Ratios			
Label	**Estimate**	**95% Confidence Limits**	
Venue Cafe vs Talks at Before_After=After	<0.001	.	1.436
Venue Cafe vs Walks at Before_After=After	<0.001	.	2.972
Venue Talks vs Walks at Before_After=After	1.000	.	.
Venue Cafe vs Talks at Before_After=Before	0.586	0.247	1.474
Venue Cafe vs Walks at Before_After=Before	0.868	0.337	2.324
Venue Talks vs Walks at Before_After=Before	1.481	0.701	3.067
Before_After After vs Before at Venue=Cafe	11.520	1.973	219.625
Before_After After vs Before at Venue=Talks	>999.999	13.693	.
Before_After After vs Before at Venue=Walks	>999.999	9.450	.


Odds Ratios with 95% Profile-Likelihood Confidence Limits
Venue Cafe vs Talks at Before_After=After
Venue Cafe vs Walks at Before_After=After
Venue Talks vs Walks at Before_After=After
Venue Cafe vs Talks at Before_After=Before
Venue Cafe vs Walks at Before_After=Before
Venue Talks vs Walks at Before_After=Before
Before_After After vs Before at Venue=Cafe
Before_After After vs Before at Venue=Talks
Before_After After vs Before at Venue=Walks
0
250000
500000
750000
1000000
1250000
Odds Ratio


Predicted Probabilities for Correct_num=1
1.00
0.75
0.50
0.25
0.00
Probability
After Cafe
After Talks
After Walks
Before Cafe
Before Talks
Before Walks
Before_After * Venue

Logistic Regression for Question 3

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.KNOWLEDGE
Response Variable	Correct_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	518
Number of Observations Used	462

Response Profile		
Ordered Value	**Correct_num**	**Total Frequency**
1	0	26
2	1	436

Probability modeled is Correct_num=1.

Note: 56 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information			
Class	**Value**	**Design Variables**	
Before_After	**After**	1	
	Before	0	
Venue	**Cafe**	1	0
	Talks	0	1
	Walks	-1	-1

Model Convergence Status
Quasi-complete separation of data points detected.

Warning: The maximum likelihood estimate may not exist.
Warning: The LOGISTIC procedure continues in spite of the above warning. Results shown are based on the last maximum likelihood iteration. Validity of the model fit is questionable.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	202.137	182.118
SC	206.272	206.932
-2 Log L	200.137	170.118

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	30.0185	5	<.0001
Score	28.2357	5	<.0001
Wald	13.1775	5	0.0218

Type 3 Analysis of Effects

Effect	DF	Wald Chi-Square	Pr > ChiSq
Venue	2	5.0273	0.0810
Before_After	1	0.0044	0.9470
Before_After*Venue	2	0.0027	0.9986

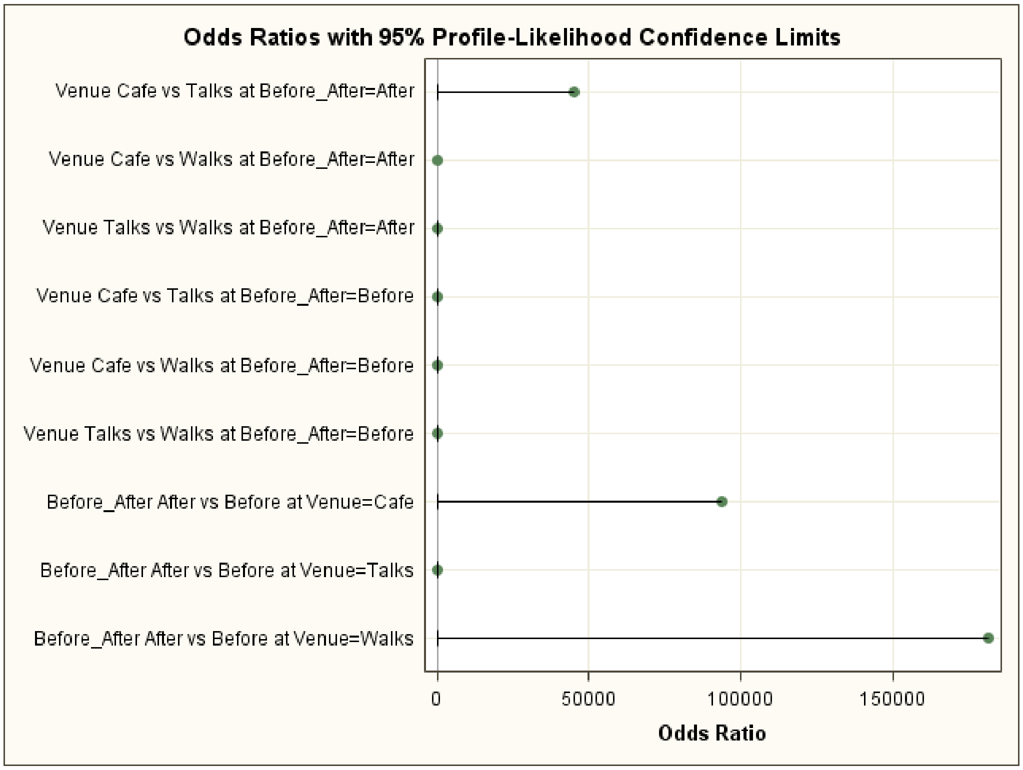
Analysis of Maximum Likelihood Estimates

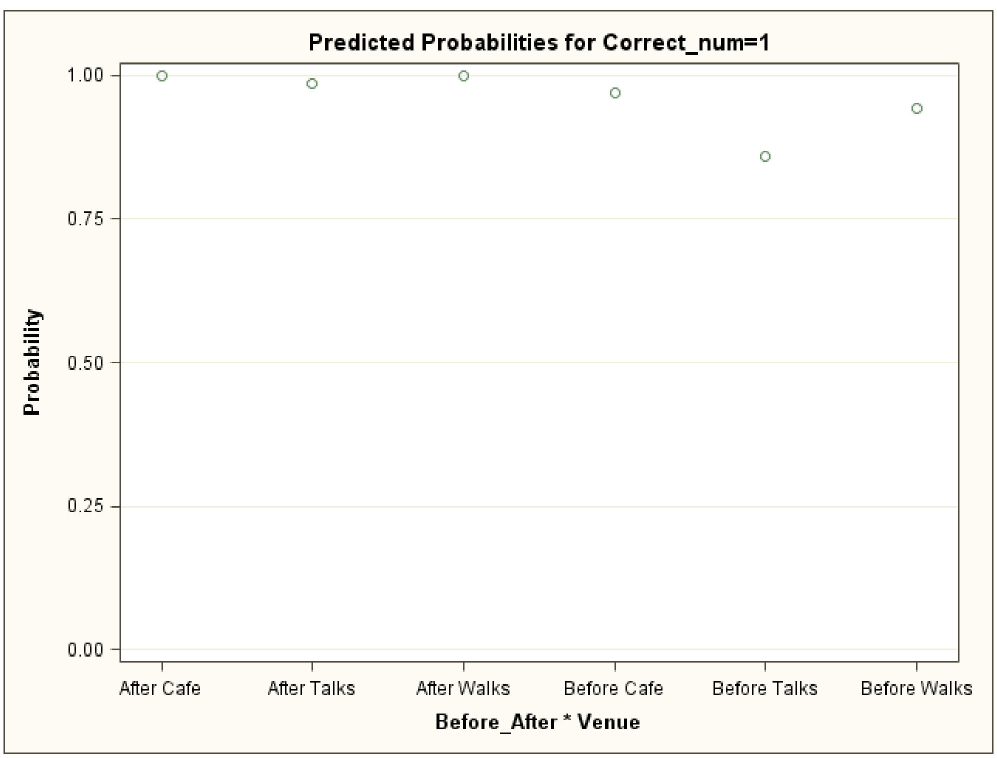
Parameter			DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept			1	2.6927	0.3884	48.0668	<.0001
Venue	Cafe		1	0.7730	0.7033	1.2081	0.2717
Venue	Talks		1	-0.8836	0.4138	4.5586	0.0328
Before_After	After		1	8.6449	130.1	0.0044	0.9470
Before_After*Venue	After	Cafe	1	2.8010	226.5	0.0002	0.9901
Before_After*Venue	After	Talks	1	-6.2644	130.1	0.0023	0.9616

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	66.1	**Somers' D**	0.567
Percent Discordant	9.5	**Gamma**	0.749
Percent Tied	24.4	**Tau-a**	0.060
Pairs	11336	**c**	0.783

Profile Likelihood Confidence Interval for Odds Ratios

Label	Estimate	95% Confidence Limits	
Venue Cafe vs Talks at Before_After=After	>999.999	0.133	.
Venue Cafe vs Walks at Before_After=After	1.000	.	.
Venue Talks vs Walks at Before_After=After	<0.001	.	3.542
Venue Cafe vs Talks at Before_After=Before	5.241	1.025	95.900
Venue Cafe vs Walks at Before_After=Before	1.939	0.273	38.741
Venue Talks vs Walks at Before_After=Before	0.370	0.104	1.034
Before_After After vs Before at Venue=Cafe	>999.999	0.151	.
Before_After After vs Before at Venue=Talks	10.810	3.051	68.749
Before_After After vs Before at Venue=Walks	>999.999	1.464	.


Odds Ratios with 95% Profile-Likelihood Confidence Limits
Venue Cafe vs Talks at Before_After=After
Venue Cafe vs Walks at Before_After=After
Venue Talks vs Walks at Before_After=After
Venue Cafe vs Talks at Before_After=Before
Venue Cafe vs Walks at Before_After=Before
Venue Talks vs Walks at Before_After=Before
Before_After After vs Before at Venue=Cafe
Before_After After vs Before at Venue=Talks
Before_After After vs Before at Venue=Walks
0
50000
100000
150000
Odds Ratio


Predicted Probabilities for Correct_num=1
Probability
1.00
0.75
0.50
0.25
0.00
After Cafe
After Talks
After Walks
Before Cafe
Before Talks
Before Walks
Before_After * Venue

Logistic Regression for Question 4

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.KNOWLEDGE
Response Variable	Correct_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	518
Number of Observations Used	475

Response Profile		
Ordered Value	**Correct_num**	**Total Frequency**
1	0	125
2	1	350

Probability modeled is Correct_num=1.

Note: 43 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information			
Class	**Value**	**Design Variables**	
Before_After	**After**	1	
	Before	0	
Venue	**Cafe**	1	0
	Talks	0	1
	Walks	-1	-1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	549.517	442.435
SC	553.681	467.415
-2 Log L	547.517	430.435

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	117.0826	5	<.0001
Score	106.7696	5	<.0001
Wald	72.5981	5	<.0001

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
Venue	2	27.8541	<.0001
Before_After	1	25.5546	<.0001
Before_After*Venue	2	9.0812	0.0107

Analysis of Maximum Likelihood Estimates							
Parameter			DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept			1	0.3378	0.1571	4.6217	0.0316
Venue	Cafe		1	-0.2201	0.2531	0.7561	0.3846
Venue	Talks		1	0.9393	0.1985	22.3940	<.0001
Before_After	After		1	1.5312	0.3029	25.5546	<.0001
Before_After*Venue	After	Cafe	1	0.3320	0.4753	0.4880	0.4848

Analysis of Maximum Likelihood Estimates

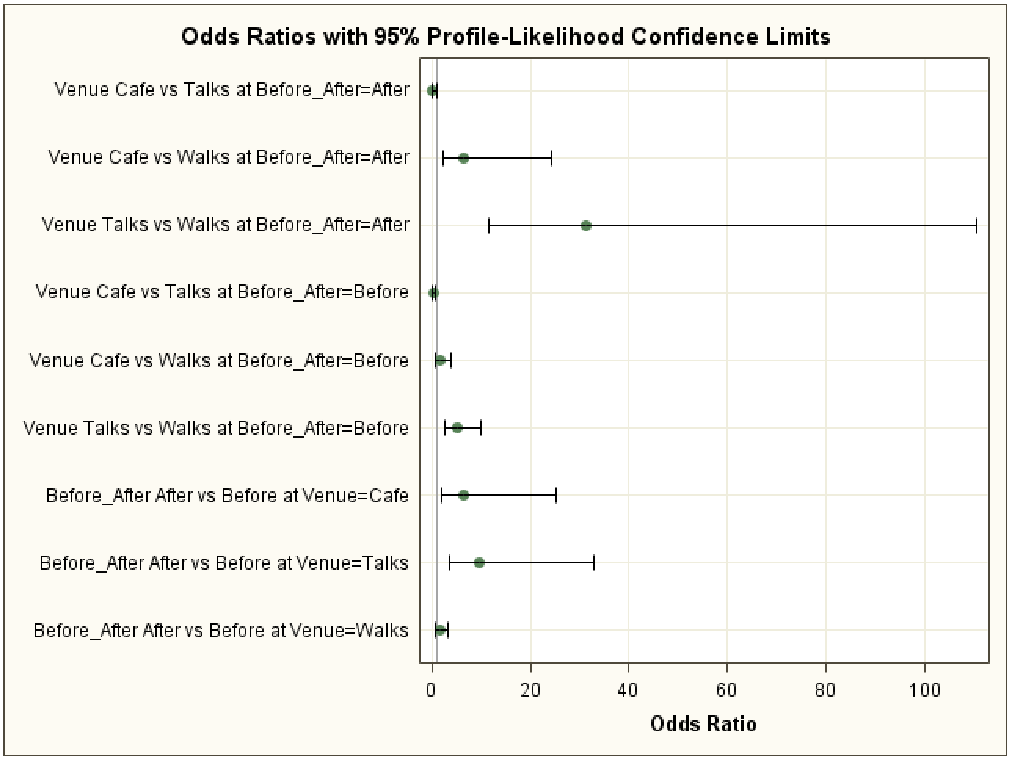
Parameter			DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Before_After*Venue	**After**	**Talks**	1	0.7254	0.4384	2.7377	0.0980

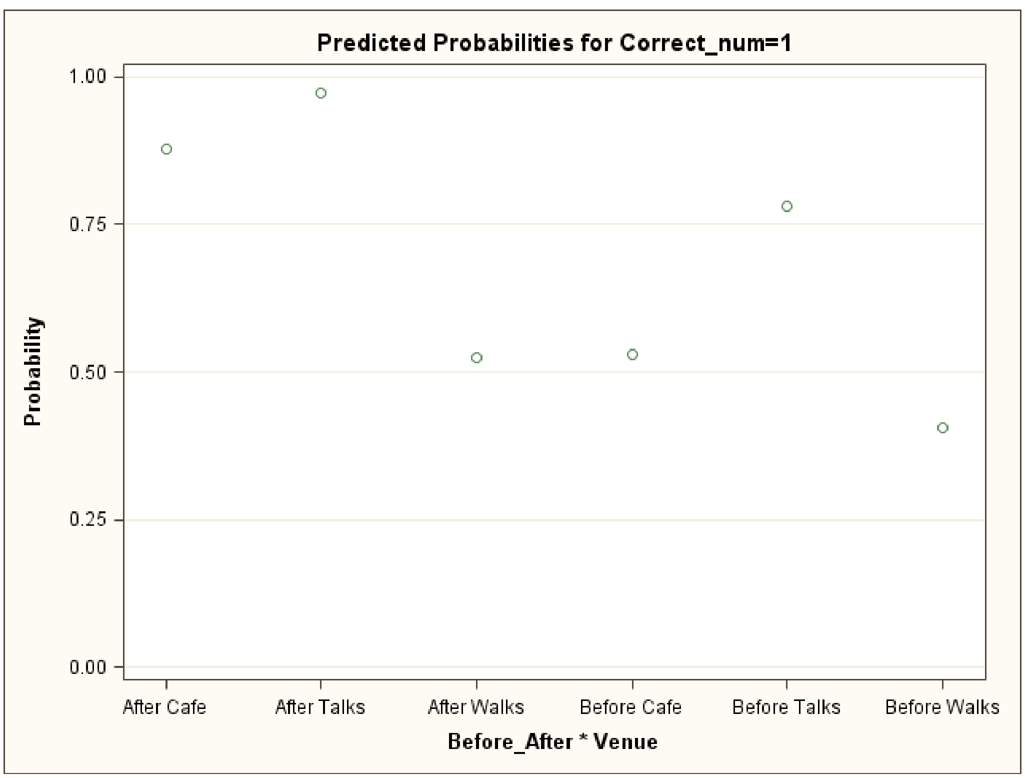
Association of Predicted Probabilities and Observed Responses

Percent Concordant	72.7	**Somers' D**	0.595
Percent Discordant	13.2	**Gamma**	0.693
Percent Tied	14.1	**Tau-a**	0.231
Pairs	43750	**c**	0.798

Profile Likelihood Confidence Interval for Odds Ratios

Label	Estimate	95% Confidence Limits	
Venue Cafe vs Talks at Before_After=After	0.212	0.048	0.941
Venue Cafe vs Walks at Before_After=After	6.610	2.284	24.184
Venue Talks vs Walks at Before_After=After	31.228	11.435	110.385
Venue Cafe vs Talks at Before_After=Before	0.314	0.142	0.693
Venue Cafe vs Walks at Before_After=Before	1.647	0.721	3.803
Venue Talks vs Walks at Before_After=Before	5.251	2.816	10.010
Before_After After vs Before at Venue=Cafe	6.444	2.003	25.334
Before_After After vs Before at Venue=Talks	9.550	3.620	32.943
Before_After After vs Before at Venue=Walks	1.606	0.813	3.202


Odds Ratios with 95% Profile-Likelihood Confidence Limits
Venue Cafe vs Talks at Before_After=After
Venue Cafe vs Walks at Before_After=After
Venue Talks vs Walks at Before_After=After
Venue Cafe vs Talks at Before_After=Before
Venue Cafe vs Walks at Before_After=Before
Venue Talks vs Walks at Before_After=Before
Before_After After vs Before at Venue=Cafe
Before_After After vs Before at Venue=Talks
Before_After After vs Before at Venue=Walks
0
20
40
60
80
100
Odds Ratio


Predicted Probabilities for Correct_num=1
Probability
1.00
0.75
0.50
0.25
0.00
After Cafe
After Talks
After Walks
Before Cafe
Before Talks
Before Walks
Before_After * Venue

Logistic Regression for Question 5

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.KNOWLEDGE
Response Variable	Correct_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	518
Number of Observations Used	467

Response Profile

Ordered Value	Correct_num	Total Frequency
1	0	155
2	1	312

Probability modeled is Correct_num=1.

Note: 51 observations were deleted due to missing values for the response or explanatory variables.

Class Level Information

Class	Value	Design Variables	
Before_After	**After**	1	
	Before	0	
Venue	**Cafe**	1	0
	Talks	0	1
	Walks	-1	-1

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics		
Criterion	**Intercept Only**	**Intercept and Covariates**
AIC	595.576	426.914
SC	599.722	451.792
-2 Log L	593.576	414.914

Testing Global Null Hypothesis: BETA=0			
Test	**Chi-Square**	**DF**	**Pr > ChiSq**
Likelihood Ratio	178.6622	5	<.0001
Score	159.6733	5	<.0001
Wald	107.9746	5	<.0001

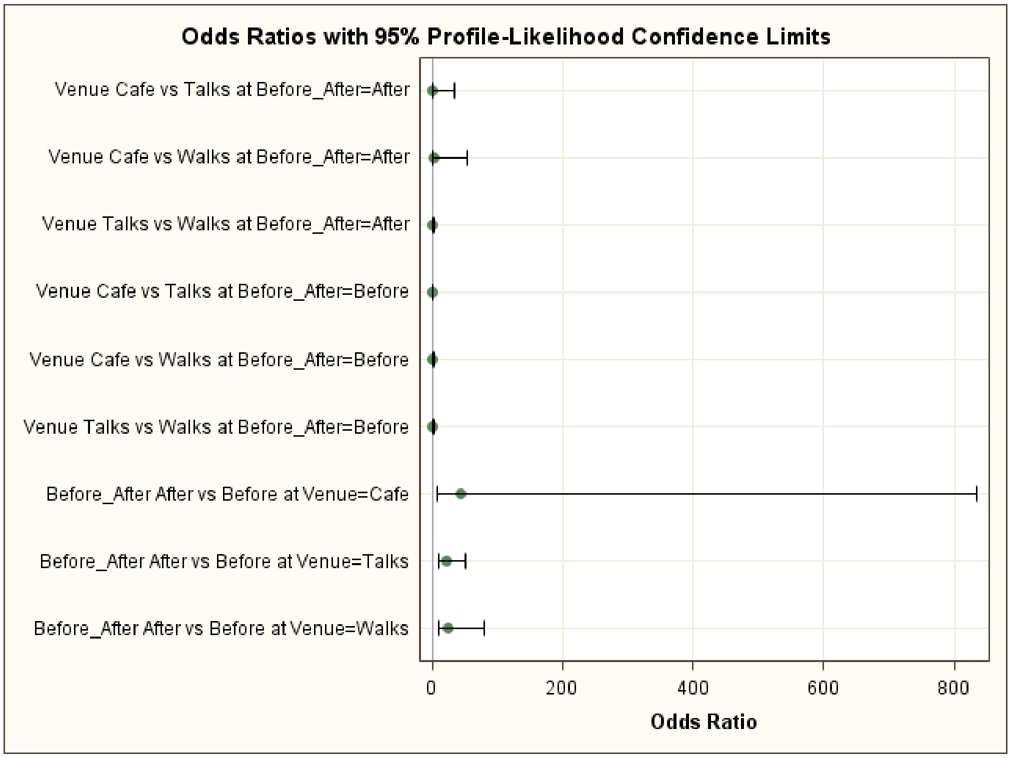
Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
Venue	2	2.6308	0.2684
Before_After	1	63.4224	<.0001
Before_After*Venue	2	0.3920	0.8220

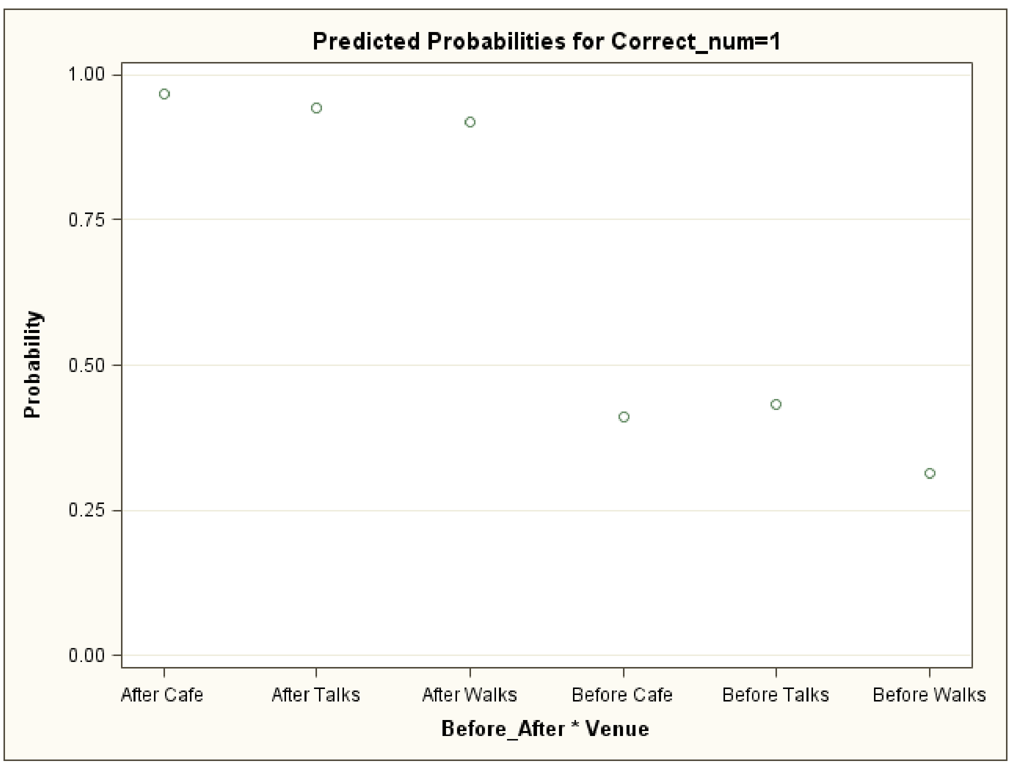
Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	-0.4717	0.1569	9.0357	0.0026
Venue	**Cafe**		1	0.1151	0.2552	0.2034	0.6520
Venue	**Talks**		1	0.1973	0.1869	1.1148	0.2910
Before_After	**After**		1	3.3621	0.4222	63.4224	<.0001
Before_After*Venue	**After**	**Cafe**	1	0.4286	0.7502	0.3264	0.5678
Before_After*Venue	**After**	**Talks**	1	-0.2843	0.4824	0.3472	0.5557

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	75.5	**Somers' D**	0.652
Percent Discordant	10.3	**Gamma**	0.760
Percent Tied	14.3	**Tau-a**	0.290
Pairs	48360	**c**	0.826

Profile Likelihood Confidence Interval for Odds Ratios

Label	Estimate	95% Confidence Limits	
Venue Cafe vs Talks at Before_After=After	1.879	0.327	35.499
Venue Cafe vs Walks at Before_After=After	2.719	0.414	53.299
Venue Talks vs Walks at Before_After=After	1.447	0.422	4.530
Venue Cafe vs Talks at Before_After=Before	0.921	0.422	1.968
Venue Cafe vs Walks at Before_After=Before	1.533	0.647	3.615
Venue Talks vs Walks at Before_After=Before	1.665	0.903	3.136
Before_After After vs Before at Venue=Cafe	44.285	8.005	834.552
Before_After After vs Before at Venue=Talks	21.711	10.368	51.514
Before_After After vs Before at Venue=Walks	24.971	9.449	79.826


Odds Ratios with 95% Profile-Likelihood Confidence Limits
Venue Cafe vs Talks at Before_After=After
Venue Cafe vs Walks at Before_After=After
Venue Talks vs Walks at Before_After=After
Venue Cafe vs Talks at Before_After=Before
Venue Cafe vs Walks at Before_After=Before
Venue Talks vs Walks at Before_After=Before
Before_After After vs Before at Venue=Cafe
Before_After After vs Before at Venue=Talks
Before_After After vs Before at Venue=Walks
0
200
400
600
800
Odds Ratio


Predicted Probabilities for Correct_num=1
1.00
0.75
0.50
0.25
0.00
Probability
After Cafe
After Talks
After Walks
Before Cafe
Before Talks
Before Walks
Before_After * Venue

APPENDIX E: SAS CODE AND OUTPUT FOR ATTITUDE

Code:

```
title 'Logistic Regression for Attitude';
ods graphics on;
proc logistic data= sasuser.Attitude plots(only)=(effect oddsratio) ;
class Before_After (param=ref ref='Before')
      Venue (param=effect);
        model Response_num (event='1') = Venue Before_After
Venue*Before_After/
                  clodds=pl;

oddsratio Venue / at (Venue = all) cl=pl;
oddsratio Before_After / at (Before_After = all) cl=pl;
run;
```

Output:

Logistic Regression for Attitude

The LOGISTIC Procedure

Model Information	
Data Set	SASUSER.ATTITUDE
Response Variable	Response_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	322
Number of Observations Used	322

Response Profile		
Ordered Value	**Response_num**	**Total Frequency**
1	0	72
2	1	250

Probability modeled is Response_num=1.

Class Level Information

Class	Value	Design Variables	
Before_After	After	1	
	Before	0	
Venue	Cafe	1	0
	Talk	0	1
	Walk	-1	-1

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	344.241	345.758
SC	348.015	368.405
-2 Log L	342.241	333.758

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	8.4830	5	0.1315
Score	8.2378	5	0.1436
Wald	7.9886	5	0.1569

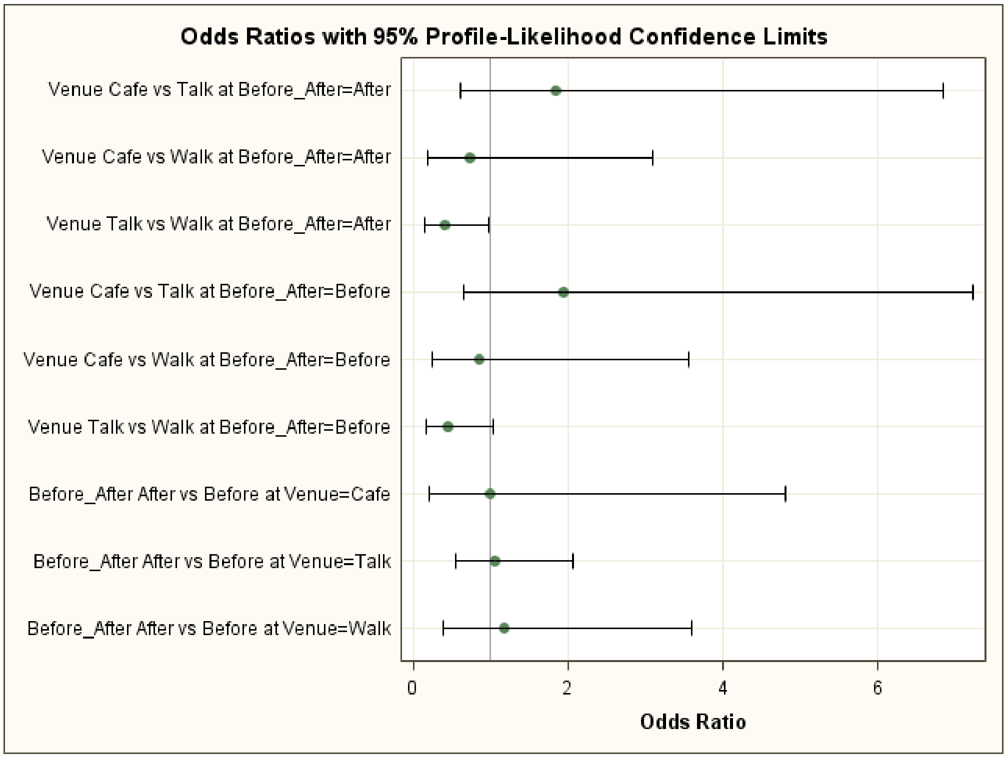
Type 3 Analysis of Effects

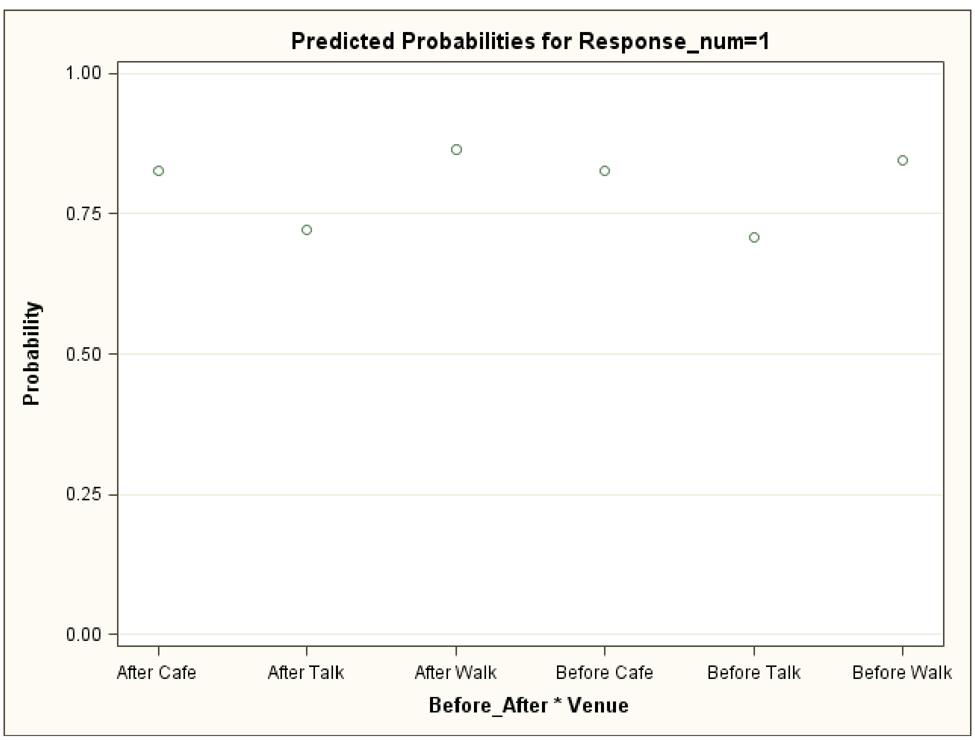
Effect	DF	Wald Chi-Square	Pr > ChiSq
Venue	2	3.8040	0.1493
Before_After	1	0.0440	0.8339
Before_After*Venue	2	0.0330	0.9836

Analysis of Maximum Likelihood Estimates							
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept			1	1.3850	0.2373	34.0662	<.0001
Venue	**Cafe**		1	0.1732	0.3965	0.1908	0.6622
Venue	**Talk**		1	-0.4930	0.2741	3.2357	0.0720
Before_After	**After**		1	0.0710	0.3387	0.0440	0.8339
Before_After*Venue	**After**	**Cafe**	1	-0.0710	0.5625	0.0159	0.8995
Before_After*Venue	**After**	**Talk**	1	-0.0139	0.3908	0.0013	0.9715

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	49.1	**Somers' D**	0.204
Percent Discordant	28.7	**Gamma**	0.262
Percent Tied	22.1	**Tau-a**	0.071
Pairs	18000	**c**	0.602

Profile Likelihood Confidence Interval for Odds Ratios			
Label	**Estimate**	**95% Confidence Limits**	
Venue Cafe vs Talk at Before_After=After	1.839	0.614	6.832
Venue Cafe vs Walk at Before_After=After	0.739	0.198	3.092
Venue Talk vs Walk at Before_After=After	0.402	0.149	0.972
Venue Cafe vs Talk at Before_After=Before	1.947	0.652	7.221
Venue Cafe vs Walk at Before_After=Before	0.864	0.240	3.551
Venue Talk vs Walk at Before_After=Before	0.444	0.173	1.039
Before_After After vs Before at Venue=Cafe	1.000	0.208	4.798
Before_After After vs Before at Venue=Talk	1.059	0.545	2.060
Before_After After vs Before at Venue=Walk	1.169	0.388	3.597


Odds Ratios with 95% Profile-Likelihood Confidence Limits
Venue Cafe vs Talk at Before_After=After
Venue Cafe vs Walk at Before_After=After
Venue Talk vs Walk at Before_After=After
Venue Cafe vs Talk at Before_After=Before
Venue Cafe vs Walk at Before_After=Before
Venue Talk vs Walk at Before_After=Before
Before_After After vs Before at Venue=Cafe
Before_After After vs Before at Venue=Talk
Before_After After vs Before at Venue=Walk
0
2
4
6
Odds Ratio


Predicted Probabilities for Response_num=1
1.00
0.75
0.50
0.25
0.00
Probability
After Cafe
After Talk
After Walk
Before Cafe
Before Talk
Before Walk
Before_After * Venue